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DEPARTMENT OF TRANSPORTATION

National Highway Traffic Safety Administration

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PASSENGER AUTOMOBILE AVERAGE FUEL ECONOMY STANDARDS

Final Rule

Title 49—Transportation

CHAPTER V—NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

[Docket No. FE 76-1; Notice 5]

PART 531—PASSENGER AUTOMOBILE AVERAGE FUEL ECONOMY STANDARDS

Final Rule

AGENCY: National Highway Traffic Safety Administration, Department of Transportation.

ACTION: Final rule.

SUMMARY: This notice establishes average fuel economy standards for passenger automobiles manufactured in model years 1981–84. These standards are 22 miles per gallon (mpg) for passenger automobiles produced in model year 1981, 24 mpg for 1982, 26 mpg for 1983, and 27 mpg for 1984. These standards are promulgated to satisfy the requirements of section 502(a)(3) of the Motor Vehicle Information and Cost Savings Act, as amended. The establishment of these standards is intended to result in the consumption of approximately 41 billion fewer gallons of gasoline (worth $19 billion, with gasoline valued at 65¢ per gallon) over the life of the vehicles manufactured in 1981–84 than would be the case if the average fuel economy of new passenger automobiles remained at the level of the 1980 fuel economy standard, 20.0 mpg.

DATES: These standards will apply to the model years 1981 through 1984.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION:

I. Background Information

Title V of the Motor Vehicle Information and Cost Savings Act, as amended (hereafter, "the Act"), establishes average fuel economy standards applicable to manufacturers of passenger automobiles. Title V was added to the Act by Part A of Title III of the Energy Policy and Conservation Act (hereafter, "the Energy Act"). The term "passenger automobiles" generally includes four-wheeled vehicles manufactured primarily for on-road use and for the transportation of ten or fewer passengers, e.g., sedans, coupes, and station wagons. See 15 U.S.C. 2001 (1) and (2), and 41 FR 55368, December 20, 1976. Compliance of a manufacturer with these standards is to be determined by computing the production-weighted fuel economy average of the various model types of passenger automobiles manufactured by the manufacturer in a model year and comparing that number to the fuel economy standard. Fuel economy values for the various model types of passenger automobiles are determined in accordance with procedures established by the Environmental Protection Agency. See 41 FR 38675, September 10, 1976. The Act specifies fuel economy standards of 18, 19, and 20 mpg for model years 1978, 1979, and 1980, respectively, and 27.5 mpg for 1985 and thereafter. Fuel economy standards for model years 1981–84 are to be established administratively by the Secretary of Transportation not later than July 1, 1977. See section 502(a)(3) of the Act. This notice establishes the latter standards.

Section 502(a)(3) imposes two substantive requirements for the 1981–84 standards. That section requires that the standards for each of those model years be set at a level which (1) is the maximum feasible average fuel economy level and (2) will result in steady progress toward meeting the 1985 standard. The statutorily-established standard for 1985 and thereafter of 27.5 mpg may be adjusted either upward or downward by the Secretary of Transportation if he determines that the present standard does not reflect the maximum feasible average fuel economy level for those years. If the Secretary amends the standard for any model year to a level above 27.5 mpg or below 26.0 mpg, that amendment is subject to a veto by either House of the Congress. See section 502(a)(4). In determining maximum feasible average fuel economy, the Secretary must, under section 502(e) of the Act, consider four factors: technological feasibility, economic practicability; the effect of other Federal motor vehicle standards on fuel economy; and the need of the nation to conserve energy.

Responsibility for the automotive fuel economy program was delegated by the Secretary of Transportation to the Administrator of the National Highway Traffic Safety Administration (NHTSA) in 41 FR 25015, June 22, 1976. Rulemaking under section 502(a)(3) was initiated on September 23, 1976, when the NHTSA published an advance notice of proposed rulemaking (ANPRM). See 41 FR 41713. The ANPRM solicited specific information on all subjects relevant to the establishment of 1981–84 standards, with particular emphasis on the four considerations relating to the determination of maximum feasible average fuel economy levels set forth above. Six automobile manufacturers, two industry trade associations, one state and one federal energy agency, and one private individual provided responses to the ANPRM. These responses were considered in developing the notice of proposed rulemaking and supporting materials discussed below. To encourage the representation in the proceeding of interests and points of view which have traditionally been underrepresented due to the high costs of participation, NHTSA invited applications for financial assistance from individuals and groups which were financially unable to participate. See 42 FR 5178, January 27, 1977. Five public interest organizations received funding in this first action under the Department's demonstration program for financial assistance, which was announced in 42 FR 2864, January 13, 1977.

On February 22, 1977, a notice of proposed rulemaking and public hearing (NPRM) was published in 42 FR 10321. This notice discussed in additional detail the issues which were deemed relevant to the establishment of 1981–84 standards. The notice also announced the availability of a document titled "Data and Analysis for 1981–84 Passenger Automobile Fuel Economy Standards" (hereafter, the "Support Document"), which set forth the methodology and data on which fuel economy improvement projection would be based. This document was released on March 1, 1977. As noted in the NPRM, the Support Document projected potentially achievable fuel economy levels which would result in steady progress toward meeting 27.5 mpg by 1985. These projections were based on the use of a limited class of technological improvements, and were therefore not projections of "maximum feasible average fuel economy levels." See 42 FR 10322, and Tr-I, p. 87 (remarks of Dr. Robert Sawyer).[1] However, such projections were useful for demonstrating that average fuel economy levels in the range to be considered in this proceeding were achievable.

The NPRM also announced a public hearing to commence on March 22, 1977, to permit interested parties to make oral presentations in addition to their opportunity to make written submissions. The hearing was not required by the Act, but was held at the discretion of the Secretary to augment the opportunity for public participation in this important informal rulemaking action. The Secretary of Transportation presided over the first day of the hearing, together with the Administrator of the Federal Energy Administration and the Deputy Administrator of the Environmental Protection Agency. Representatives of the latter agencies also participated throughout the remainder of the hearing. Eleven companies, groups and individuals made presentations at the hearing, including five passenger automobile companies and four funded public interest groups. The NPRM established a deadline of April 7, 1977, for the submission of written comments on the NPRM and the Support Document and on issues raised at the hearing. This deadline was extended on April 1, 1977, to April 12, 1977, at the request of Chrysler Corporation[2], to al-

[1] The abbreviation "Tr" refers to the transcript of the fuel economy public hearing, copies of which are in the fuel enonomy docket. The roman numeral following the abbreviation refers to the transcript volume, "I" being the Tuesday, March 22 volume, "II" being the March 23 volume, and "III" being the March 24 volume. References to the transcript and other materials are intended as an aid to persons dealing with the voluminous materials in this rulemaking, and may not be exhaustive.

[2] DN-25. The abbreviation "DN" followed by a number refers to the docket number of material in NHTSA docket FE 76-01-NO3. This docket is located in Room 5108 of the Nassif Building, 400 Seventh Street, SW., Washington, D.C. and is open to the public during normal business hours.

low additional time for the preparation of responses to questions for which the hearing panel received no answer at the hearing. See 42 FR 18413, April 7, 1977. To assure fully responsive answers to certain important questions asked at the public hearing, "special orders" were issued on April 1, 1977, under section 505(b)(1) of the Act to the five automobile companies which participated in the hearing. DN–7. In addition, on April 21, similar special orders were issued to certain foreign passenger automobile manufacturers to obtain information on their capabilities to achieve high levels of average fuel economy. DN–28. On April 20, special orders were sent to five automobile equipment and material suppliers to obtain information on the fuel economy improvement potential and cost associated with the equipment and material they could supply to passenger automobile manufacturers in the 1981–84 period. DN–27. An additional special order was issued on May 19 to the recipients of the April 1 order to obtain further information on the impact of the Administration's proposed emission standards and energy plan on fuel economy. DN–35. All comments and responses have been considered and the most significant are discussed below.

Material contained in the Support Document, as supplemented or revised in light of material submitted in response to the NPRM and special orders, together with other relevant material, were used in the development of the standards promulgated herein. More detailed information including more extensive data and analyses used in the development of these standards is contained in a Rulemaking Support Paper (hereafter, the "RSP"), copies of which will soon be available from the Office of Automotive Fuel Economy (NFE–01), National Highway Traffic Safety Administration, 400 Seventh Street SW., Washington, D.C. 20590 or by calling 202–472–5906. The data and analyses in that paper appear to justify average fuel economy standards more stringent than 27.5 mpg by 1985. However, the scope of notice limits this final rule to standards for 1981–84. Thus, the statutory standard of 27.5 mpg for 1985 and thereafter cannot be changed by this rulemaking. Further, standards of 27.5 mpg or higher cannot be set for any year before 1985 so long as the 1985 standard remains at 27.5 mpg. This second limitation results from the statutory requirement that the 1981–84 standards lead to steady progress toward the 1985 standard.

It should be noted that these limitations on the 1981–85 standards are only temporary. Shortly, the Department intends to exercise its authority under section 502(a)(4) of the Act to initiate rulemaking to increase the average fuel economy standards for 1985 and thereafter. At that time, the relation between the new standard for 1985 and the standards for 1981–84 established herein will be considered. A further discussion of this topic is contained in section XII below.

II. Methodology on Which Standards Are Based

A. *The methodological approach.* In view of the statutory requirement for maximum feasible standards and of the nation's need to conserve energy, the Department has attempted to set fuel economy standards at the most stringent possible level, consistent with other statutory requirements. At least two approaches exist for determining such maximum levels. One approach is to evaluate the most fuel efficient passenger automobiles produced today in each of the various market classes of automobiles, and to use that evaluation to set improvement targets for all other automobiles in the same class. This approach has the advantage of providing a clear basis for evaluating current technological capabilities. However, to the extent that the best of the present vehicles, or even existing prototype vehicles, do not employ all available fuel economy-improving technology, this approach does not truly measure even current maximum capabilities. Further, it does not consider technological improvements that will occur in time to be incorporated in the 1981–84 passenger automobiles. Therefore, in developing 1981–84 fuel economy standards, the Department has employed a different approach. The adopted methodology looks at present passenger automobiles and projects the impact of applying current and expected future technology to those vehicles. This approach has the disadvantage that no one has actually built or tested a vehicle that combines the technological attributes of the vehicles postulated in the analysis. However, the Department is convinced that the individual technological improvements considered in this analysis have been sufficiently well demonstrated through engineering analysis and other means that the combined fuel economy projections provide a reliable estimate of the achievable fuel economy of future passenger automobiles.

The Department's analysis started with the detailed schedules for downsizing, weight reduction through materials substitution and matching of engines with vehicles by the four major domestic manufacturers, as contained in the Support Document. Then the schedules for inertia weight reduction over the period 1981–85 were revised to reflect further information. The projected fuel economy results for each manufacturer for each year were then revised to reflect the new weight estimates as well as the Department's assessment that an average 10 percent reduction in acceleration performance could be achieved by the 1981 model year to increase fuel economy by an additional 4 percent.

Next, the percentage increases in fuel economy due to technological improvements in transmissions, aerodynamic drag, rolling resistance, engine and vehicle accessories, and lubricants were evaluated and these technological improvements were projected to be phased-in to the 1981–1985 vehicles at various rates for each manufacturer. The phase-in schedules took into account differences in capability for implementation among the manufacturers.

The technologies and the associated increases in fuel economy are:

	Percent
Improved automatic transmission	10
Improved manual transmission	5
Improved lubricants	2
Reduced accessory loads	2
Reduced aerodynamic drag	4
Reduced rolling resistance	3

In addition, the assessment included a 1 percent fuel economy penalty due to safety standards necessary to assure adequate levels of crash survivability in the automobile fleet of the 1980's. See RSP.

Finally, the distribution of car sizes for each manufacturer was assumed to be approximately the same as in 1976.

The diesel engine was also considered in the assessment. It is available to manufacturers as an alternative way to obtain increased fuel economy and the Department concludes that manufacturers potentially could achieve a 25 percent penetration of diesel engine powered passenger automobiles by 1985. Similarly, the Department considered a shift in size distribution to 10 percent large cars, 25 percent midsize, 25 percent compact, and 40 percent subcompact by 1985 as a way to obtain a further increase in fuel economy. Diesel engines and mix shifts were placed in a "safety margin" category of technologically feasible means for the purposes of this rulemaking.

The economic practicability of the specific technical approach to improving fuel economy was examined in depth. The assessment considered the cost to the manufacturer of the needed capital facilities and the variable costs associated with the various technological improvements in fuel economy. It projected price increases based on those cost estimates. It examined the overall costs to the consumer due to changes in new car prices, improvements in fuel economy, and changes in maintenance costs over the life of the car. It considered the impacts of price and fuel economy changes upon new car sales. It examined in some depth the capability of the four domestic manufacturers to finance the capital facilities and equipment out of revenue.

This approach results in a demonstration of *one* feasible path for attainment of the fuel economy standards, which, however, is not necessarily the least cost or lowest risk path for each automobile manufacturer to adopt to achieve compliance. Since the fuel economy standards are "performance standards," manufacturers are free to select any alternative path for achieving compliance. Even if the Department had based its fuel economy projections on the use of all known technology, manufacturers would still have the flexibility in achieving compliance. In some cases, the Department's analysis makes an allowance for alternative technologies (e.g., downsizing or material substitution to achieve weight reduction) from which manufacturers may select. In addition, manu-

facturers may increase the percent of their production for which some methods are used and thereby generate flexibility to decrease the usage of some other method. The manufacturers may vary the intensity with which they apply a particular method, for example, achieving a greater or lesser reduction in weight or acceleration capability. Many of the achieveable improvements assumed in the analysis are based on projections of fuel economy improvement potential which the Department considers conservative. If improvements in fuel economy greater than those projected are in fact realized, more flexibility is obtained. Finally, any new technological developments over the intervening years would generate additional flexibility. For these reasons, it is clear that, even excluding the measures comprising the compliance safety margin provided in this analysis, alternate approaches to complying with fuel economy standards will be open to the automobile manufacturers.

B. *Statutory requirements.* Section 502 of the Act provides guidance regarding the analysis to be used in setting the 1981–84 fuel economy standards. The first required step is to determine the "maximum feasible average fuel economy level." The first consideration required under section 502(e) in determining that level is "technological feasibility." The Department interprets the latter phrase, in the context of the "maximum feasible" requirement and the methodological approach discussed above, as presenting the question of whether the various technological options for improving fuel economy are, individually and when used with other options, capable of commercial application in 1981–84. Therefore, the technology considered in the Department's assessment is not limited to that presently in production. If it can be reasonably projected that the technology will become available in time to be applied in a specified model year, its use is technologically feasible in that year. See generally "Chrysler Corp. v. Department of Transportation," 472 F. 2d 659 (6th Cir. 1972), at 671–3; "International Harvester v. Ruckelshaus," 478 F. 2d 615 (D.C. Cir. 1973), at 628–9. Although marketing strategies for encouraging the purchase of fuel efficient passenger automobiles are not items of technology, those strategies have been included in the "mix shift" portion of the discussion of the technology-based average fuel economy projections. Given the use of "maximum", the Act must be construed to require the Department to base its analysis on the use of all feasible methods for improving average fuel economy.

The NPRM, at 42 FR 10322, solicited comment on the second statutory consideration, "economic practicability." Ford Motor Company argued that this consideration, along with the technological feasibility consideration, requires the Department to reject any level of standards which would create even a risk of reductions in industry sales, employment or profits or of restrictions in the mix of automobiles offered for sale. DN–15, Document II, p. 2. Ford suggests basing the standards on a "risk-benefit" analysis. Chrysler Corporation argued that the term means as a minimum that "the various manufacturers are financially capable of taking the necessary steps to insure compliance." DN–30, p. 20. Chrysler goes on to state that the analysis should require a consideration of the impacts of the proposed standards on employment, inflation, and consumers. The Department's view on this issue is more consistent with that of Chrylser than with Ford's.

The dictionary meaning of the word "practicable" is that something is "capable of being put into practice, done or accomplished." Webster's Third New International Dictionary 1780 (1961), 8 Oxford English Dictionary p. 1218 (1970). "Economic practicability" is nowhere defined in the Act. However, similar terms, "economically justified" and "economically feasible," are used in Part B of Title III of the Energy Act, and it is possible to infer the meaning of "economic practicability" from the use of those terms. The word "practicable" is synonymous with "feasible," according to the Oxford definition. This appears to be consistent with the way the term is used in the Act.

Section 325(a)(4)(D) defines "economically justified":

> • • • improvement of energy efficiency is economically justified if it is economically feasible the benefits of reduced energy consumption, and the savings in operating costs throughout the estimated average life of the covered product, outweigh—
>
> (i) Any increase to purchasers in initial charges for, or maintenance expenses of, the covered product which is likely to result from the imposition of the standard.
>
> (ii) Any lessening of the utility or the performance of the covered product, and
>
> (iii) Any negative effects on competition.

It should be noted that "economically feasible the benefits of" is a grammatical error which appears in the Energy Act itself as well as the Conference Report. The legislative history indicates that it should probably be read "economically feasible and if the benefits of."

Section 325 clearly contemplates that a standard must be both economically feasible and justified on a cost-benefit basis. Since Congress used the two concepts separately, it obviously did not intend them to be synonymous, i.e., economically feasible is not the same as cost-beneficial. This is further made clear by the definition of feasibility in the Conference Report:

> The term feasibility is used in section 325 in the strict sense, namely "capable of being carried out". Economic feasibility refers to whether or not a manufacturer has the economic capability to carry out the requirements of an energy efficiency standard. S. Rep. No. 94–516, H.R. Rep. No. 94–700 (94th Cong., 1st Sess.) at 172.

In the dictionary definitions listed above, "feasible" was listed as a synonym for "practicable", and interchanging them would lead to the conclusion that economic practicability is a separate concept from cost-beneficial (the second element of economically justifiable).

In addition, not equating cost-benefit considerations with economic practicability is consistent with the goal of achieving maximum feasible fuel economy by allowing economically and technologically possible standards which will improve fuel economy but which an analysis, subject to many practical limitations, might indicate are not cost-beneficial.

The word "practicable" appears in the other major vehicle regulatory statute that NHTSA administers, the National Traffic nd Motor Vehicle Safety Act. Section 103(a) of the Vehicle Safety Act (15 U.S.C. § 1392(a)) states, in part:

> • • • The Secretary shall establish by order appropriate Federal motor vehicle safety standards. Each such Federal motor vehicle safety standard shall be practicable • • •

Unfortunately, the term is defined neither in the Vehicle Safety Act nor its legislative history. However, the legislative history of the Vehicle Safety Act states that the determination of practicability must include consideration of technological and economic factors. Further, there is a small body of judicial interpretations of the term which outlines its contours.

First, it is clear that the term does not mean cost-beneficial. In *Chrysler Corp. v. Department of Transportation*, 472 F. 2d 659 (6th Cir. 1972), the court noted that the Automobile Manufacturers Association had suggested a number of amendments to the bill from which the Vehicle Safety Act arose, including limiting standards to those at costs commensurate with the benefits to be achieved. Id. at 672, fn. 16. and stated:

> None of these specific restraints sought by the Automobile Manufacturers Association was adopted, and we must decline to write into the Act the very same suggestions which Congress declined to write into the Act. Id. at 672, fn. 16.

Considering the definition of "economically justifiable" that Congress placed in Part B but not Part A of Title III of the Energy Act, the Department must likewise decline any invitation to write such limitation into Part A.

What "practicability" does mean is suggested in the following cases. In *Chrysler Corp. v. Department of Transportation*, 515 F. 2d 1053 (6th Cir. 1975), relating to rectangular headlamps, the court stated:

> A review of the cases in this area suggests the practicability requirement was designed primarily to prevent the NHTSA from establishing mandatory safety standards that are economically or technologically infeasible. (citations omitted). Id. at 1060.

In *Chrysler Corporation v. Department of Transportation*, 472 F. 2d 659 (6th Cir. 1972), relating to passive restraints the court stated:

> We do not intend to suggest that the Agency might impose standards so demanding as to require a manufacturer to perform the impossible, or impose standards so imperative as to put a manufacturer out of business. But

it is clear from the Act and its legislative history that the Agency may issue standards requiring future levels of motor vehicle performance which the manufacturers could not meet unless they devoted more of their resources to producing additional safety technology than they might otherwise do.

Id. at 672. It should be noted that this explicitly recognizes the Department's authority to set standards at non-free market dictated levels, i.e., at levels not fully cost justified under traditional free market economic theory.

Finally, in *H & H Tire Co.* v. *U.S. Department of Transportation*, 471 F. 2d 350 (7th Cir. 1972) the Court said:

We agree with the Government that "the fact that a government regulation may cause economic hardship to a party does not make such regulation unreasonable." Id. at 354.

Congress was presumably aware of the judicial interpretation of this term. It can be inferred from Congress' use of the same term in the Cost Savings Act as in the Vehicle Safety Act, both of which are overseen by the Commerce Committee and administered by the NHTSA, that Congress intended the same interpretation in both cases.

Considering all these factors, the Department concludes that "economic practicability" should be interpreted as requiring the standards to be within the financial capability of the industry, but not so stringent as to threaten substantial economic hardship for the industry. A cost-benefit analysis would be useful in considering these factors, but sole reliance on such an analysis would be contrary to the mandate of the Act.

The third consideration in determining "maximum feasible average fuel economy" levels is "the effect of other Federal motor vehicle standards on fuel economy." This term is interpreted to call for making a straight-forward adjustment to the fuel economy improvement projections to account for the impacts of other Federal standards, principally those in the areas of emission control, occupant safety, vehicle damageability, and vehicle noise. However, only the unavoidable consequences of compliance with these standards should be accounted for. The automobile manufacturers must be expected to adopt those feasible methods of achieving compliance with other Federal standards which minimize any adverse fuel economy effects of those standards.

The final statutory consideration is the "need of the Nation to conserve energy." The Support Document contains information on this topic, including a discussion of the impact of our national need to import large quantities of petroleum, and the impact of various automotive fuel economy standards schedules on such importation. No participant in the rulemaking proceeding disputed the importance of the need to conserve energy. The magnitude and prominence of this need have increased in the years since Congress' amendment of the Act. It must be recognized that achieving improvements in automobile fuel economy, no matter how great, will not by itself solve the national energy problem. Maximum conservation efforts must be made in all areas of energy consumption if the nation is to begin to solve its overall energy problem. It would jeopardize the overall national conservation effort if individual elements of that effort, such as the automobile fuel economy program, were to fail to require the last increments of feasible fuel savings on the sole ground that such increments are small in comparison to the overall need. Therefore, in considering various fuel economy schedules for 1981–84 passenger automobiles, the Department must select the highest schedule consistent with the other statutory requirements, due to the serious national need to conserve energy. See Federal Energy Administration submission, DN–37 pp. 1–2.

The second substantive statutory requirement for the 1981–84 standards is that they must result in "steady progress" toward meeting the 1985 standard. Although the Act does not define the term "steady progress," some guidance as to the term's meaning can be obtained by reference to the "plain meaning" of the two words, cases construing the two words, and the Act's legislative history. From a review of these materials, it appears that the term requires annual increases in average fuel economy, but with none of the annual increments varying dramatically from the other annual increases. Schedules like those suggested by American Motors Corporation (Tr–I, p. 74) and by Damiler-Benz AG, (DN–10, p. 11) which require increases in average fuel economy in only one year during the 1981–84 period, would be inconsistent with the "steady progress" requirement, even if they met the "maximum feasible" requirement, since they do not require annual progress. On the other hand, a projected maximum feasible average fuel economy level of 26 mpg for 1981 for example, would have to be adjusted downward because of the disproportionately large increment resulting for that year.

III. Determination of Maximum Feasible Average Fuel Economy Levels

A. *Technology-based fuel economy projections.* Participants in the rulemaking proceeding did not seriously challenge the appropriateness of the basic methodological approach used in the Support Document (Docket Number FE 76–01 GR–3) to project fuel economy improvement potential. That methodology assigns an analytically-derived percent average fuel economy improvement to certain options which are technologically feasible and applies that percentage to each of the various manufacturers' present passenger automobile fleets. The same implementation schedule is not used for all manufacturers nor for all automobiles in a given manufacturer's fleet due to the significant differences which exist in the financial capability and in the efficiency of the current automobiles of the various manufacturers. Rather, a maximum appropriate improvement schedule taking those factors into consideration is assigned. The technology considered in the development of the standards established in this notice are discussed in detail below. Because of the qualitative difference in the domestic automobiles and the imports, the fuel economy improvement potential of the imports will be discussed separately.

1. *Weight reduction.* The most obvious method for improving fuel economy is to make the passenger automobile lighter. For analytical purposes, the Support Document divided this option into three sub-options: downsizing; material substitution; and mix shifts. "Downsizing" referred to the reduction of vehicle weight and exterior dimensions by optimizing the vehicle design. The goal of downsizing is to reduce the exterior dimensions of the automobile without reducing significantly the interior passenger and luggage volume of the automobile. According to General Motors, this option "retains the essential characteristics of cars that meet a variety of consumer needs and desires." DN–18, Attachment VIII, p. 3. The Department notes that there is significant variation in the interior space of different passenger automobiles with the same number of seating positions and that tradeoffs between interior space and improved fuel economy are possible. "Material substitution" refers to the substitution of materials with lighter weight for a given strength, such as aluminum, plastics, and high-strength steel, for currently used materials. "Mix shifts" refers to shifting the percentages of the vehicles sold in different market classes (e.g., selling more compacts and fewer midsize automobiles). For explanation of these market classes, see the fuel economy labeling regulations established by E.P.A. in 41 FR 49753 (November 10, 1976). The automobile manufacturers generally argued that they were unable to differentiate between weight savings attributable to downsizing and material substitution, since they are both inseparable parts of the vehicle redesign process. See GM comment, DN–18, p. 11; Chrysler comment, DN–32, p. 11. Therefore, the Rulemaking Support Paper has combined the weight reduction potentials for those two methods. Mix shifts will be dealt with separately in section III.A.10.

The Support Document based its projections of feasible weight reduction through downsizing primarily on the reductions already achieved by General Motors with its large-sized vehicles and on press reports of planned downsizing of the other market classes. See Support Document 2, Volume I, page 2–7. Since these projections were based on current downsizing efforts, they may well understate the maximum potential for downsizing in 1981–84. See DN–11, p. 4, comments of Mr. Thomas Austin. In fact, Ford, in response to the April 1 special order (DN–7) projected greater total weight reduction for its fleet than NHTSA had originally assumed. DN–15, Doc. III, p. 30. GM strongly implied that a second round of downsizing, in addition to the one now underway, was

both feasible and planned. DN–18, Att. VIII, p. 3. In addition, GM submitted a "hypothetical scenario" of actions it could take to meet a standard of 27.5 mpg in 1985. DN–18, p. 12. Although GM characterizes this scenario as "drastic," the company's main concern appears to be that the scenario assumes the use of diesel engines in 25% of its automobiles and a reduction in average acceleration capability. The projected weight reductions, which are significantly greater than those initially projected by NHTSA, do not appear "drastic," and are generally consistent with Ford's projections. The reasonableness of GM's projections can also be inferred from GM's statement that the reduction assumed no mix shift toward smaller market classes (p. 12) and the fact that its projected average inertia weight for 1984 subcompacts (p. 13) is substantially higher (2690 pounds) than that of many subcompacts built today.

Additional evidence that the Support Document's projections of achievable weight reductions were unduly pessimistic was provided by Alcoa and U.S. Steel Corporation in response to the April 20 special order. See DN–27. Alcoa projected that the use of aluminum in certain vehicle components where that use is expected to be feasible by 1982 could reduce the weight of a present compact car by 415 pounds. Alcoa emphasized that that total was not based on a complete list of all feasible aluminum substitutions and that no allowance was made for propagation effects, i.e., the ability to reduce the weight of certain additional components because of weight reductions achieved in other components. DN–27–D.

Alcoa projected a material cost increase of only $33 for its proposed aluminum substitution. U.S. Steel projected a slightly greater weight reduction, at a higher cost, through the substitution of certain steel products for those presently used. DN–27–A. These projected weight reductions, which do not refer to identical lists of vehicle components, are approximately twice as great as those projected in the Support Document, Doc. 2, Vol. I, page 2–7, of 150–250 pounds. Since the Alcoa and U.S. Steel projections were not available at the time of the NPRM, the Department is reluctant at this time to revise upward its projections in this rulemaking of weight-saving potential on the basis of those submissions. However, these submissions do support the feasibility of the original weight reduction projections.

Front engine, front wheel drive power trains offer another technological option for further downsizing of passenger automobiles. GM (DN–18, p. 10) and Chrysler (DN–19, p. 7) each projected use of such power trains in their fleets in 1981–84. Their use allows additional vehicle downsizing through maximizing passenger compartment volume by elimination of the driveline tunnel and rear axle kick-up area. It may also be possible to reduce the length of the engine compartment by transverse mounting of the engine and transmission. The only projection given for fuel economy improvements associated with front wheel drive was the 5 percent figure offered by Dr. Sawyer at the hearing. Tr–III, p. 93. Although no percent improvement is assigned to front-wheel drive for the purposes of this analysis, the use of such power trains is recognized as a feasible method for optimizing vehicle design. The availability of this option, which was not part of the original DOT analysis, tends to confirm the Department's conclusion that the weight reductions projected in the Support Document are conservative estimates of the maximum feasible reductions. There appears to be no technological reason which would prohibit the use of such power trains in all vehicles, particularly if the implementation of this option were phased in concurrently with transmission changes. (See sections 3 and 4).

Therefore, the weight reductions assumed for Ford and GM have been revised to take into account the higher projections made by those companies, but not the submissions by Alcoa and U.S. Steel. In the case of AMC and Chrysler, the original projections in the Support Document have been retained, despite the claims of those two manufacturers that the Department's projections exceed their plans.[3] AMC argues that its vehicles are presently optimally designed, and that the other manufacturers' downsizing plans will merely bring the latter automobiles up to AMC's level of efficiency. DN–14, p. 1. Chrysler argues that DOT projections are 100–200 pounds too optimistic per vehicle. DN–30, p. 9. With respect to both AMC and Chrysler, there is no reason to believe that the improvements associated with material substitution are not as fully applicable to them as to Ford and GM, which did not dispute the projected improvements. Neither AMC nor Chrysler gave any indication that they presently use light-weight materials to a greater extent than their domestic competitors, and a comparison of the weights of their present vehicles confirms that there is no such difference. AMC's claim that absolutely no downsizing of its vehicles is possible must also be rejected. For example, the AMC Gremlin has less interior room than a Honda Accord, but weighs nearly 800 pounds more. See 1977 EPA/FEA Gas Mileage Guide, Second Edition, and Automotive News, 1977 Market Data Book Issue, April 27, 1977, pp. 76, 109. The AMC Hornet weighs nearly 500 pounds more than an Audi 100LS, but has less interior room. The AMC Pacer weighs nearly 600 pounds more than that same Audi model, with equivalent interior roominess. The AMC Matador weighs 168 pounds more than a large size Pontiac, based on a comparison of six-cylinder versions of both cars, but has eight less cubic feet of total interior volume. A similar comparison between present Chrysler and Ford automobiles reveals no significant differences in weight or roominess, yet Ford projects that it will achieve a significantly lower fleet average weight than Chrysler. It is significant that Chrysler engineers have projected that weight reductions of 630 pounds could be achieved through light-weight material substitution alone in a mid-size car, with "moderate changes in design and manufacturing techniques." SAE Paper # 760203, Docket FE–76–01–GR–21.[4] Those engineers project that such weight reduction techniques could be implemented in "two to three years," with a resulting fuel economy improvement of 26 percent. Therefore, the original assessments of weight reduction potential for AMC and Chrysler have been retained. The originally adopted schedule for attaining those reductions allows more time for those two companies to complete the process than in the cases of Ford and GM, in order to take into account differences in economic and product development capabilities (see Support Document, Doc. 4.). These delays provide needed flexibility for the smaller domestic manufacturers without significantly reducing total fuel savings. Table 5.1 of the RSP provides the projected fleet average inertia weights for each manufacturer and the resulting fuel economy values appear in Table 5.9.

2. *Reduction in straight-line acceleration capability.* Over a limited range of engine parameters, it is possible to achieve fuel economy improvements through reducing engine displacement or the ratio of engine speed to vehicle speed (N/V), or some combination of those two items. These reductions, while improving fuel economy, also adversely affect vehicle acceleration capability. Where it is possible to merely substitute one set of gears for another to change the axle ratio or expand the ratio of transmission gearing or where sufficient plant flexibility exists for a manufacturer to increase the production of lower displacement engines, this method of improving fuel economy can be implemented in a highly economical manner. The primary constraint which restricts the use of this method is consumer resistance, at least initially, to significantly reduced levels of vehicle acceleration. A secondary constraint is the increased difficulty of controlling NOx emissions as engine loading increases.

Therefore, in the April 1 special orders, the automobile manufacturers were required to submit estimates of the minimum level of acceleration performance which consumers currently find acceptable. DN–7, Question I.B.2. The respons-

[3] Many of the automobile manufacturers' specific objections to the percent improvements projected by the Department for various technological options are phrased in terms of differences between DOT projections and the manufacturer's present "plan." It is clear, however, that under the statute DOT's projections must be based on maximum achievable improvements, notwithstanding any contrary "plans" by the manufacturer.

[4] "SAE Papers" are technical research papers presented before the Society of Automotive Engineers. The papers cited in this notice were prepared by engineers and scientists expert in particular areas of automotive technology.

es to this question were relatively consistent. In terms of the time required for vehicles to accelerate from rest to a speed of 60 miles per hour, GM indicated that vehicles which require more than 15 seconds are "currently meeting with unfavorable consumer acceptance," (DN–18, p. 5); Ford judged the same time to be the "minimum performance acceptable without encountering consumer resistance." (DN–15, p. 11); Chrysler estimated a "threshold level" at about 17 seconds, (DN–32, p. 8); and AMC states that times in excess of 20 seconds are "clearly unacceptable" (DN–14, p. 4). However, the specified "thresholds" do not appear to be absolute minima, even at present, which all passenger automobiles must exceed. GM states that 16 percent of its present fleet of passenger automobiles presently have acceleration times poorer than its specified minimum (id., p. 5), Ford states that nearly 26 percent of its fleet is in that class (DN–43, Att. I), and AMC states that 26 percent of its sales are presently near the 20 second threshold (id., p. 4). Eight percent Chrysler's domestic fleet has acceleration times poorer than 17 seconds. DN–32–A. Large portions of all manufacturers' current import fleets have acceleration performance levels poorer than these "thresholds."

In view of these statements, it is concluded that a reduction in average passenger automobile acceleration of approximately 10 percent from the present average baseline acceleration times of approximately 14 seconds can be achieved without incurring substantial consumer resistance. This reduction roughly corresponds to a fleet average "zero-to-sixty" time of 15.4 seconds, and would be phased-in by the 1981 model year. A fuel economy benefit of four percent would result from this change.

It should be noted that several factors combine to mitigate the impact of even this relatively modest reduction. First, it is possible for the manufacturers to achieve this reduction by narrowing the range of offered acceleration characteristics, e.g., by decreasing the acceleration time for its faster automobiles. Even under the GM "Hypothetical Scenario," which assumed a greater performance reduction than the one projected here, the reduction in average acceleration performance is achieved while concurrently improving the performance of the slowest of GM's present passenger automobiles. DN–18, p. 17. In addition, it may be possible for the manufacturers to offset this performance reduction in their passenger automobiles. At the same time that a manufacturer switches from an 8-cylinder engine to a 6-cylinder engine or lowers the N/V ratio, it could increase the acceleration performance of whatever engine is used by using a turbocharger or fuel injection system. The use of this alternate technology may even result in a net fuel economy benefit, in some cases. DN–16, p. 1 (Volkswagen) and DN–27B, p. 2 and Attachment (Bendix). Fuel injection is presently used on a number of passenger automobiles, and at least one manufacturer plans to use turbochargers in the near future. DN–18, p. 9 (GM). Volkswagen, under DOT contract, tested a turbocharged version of the Diesel Rabbit and achieved a fuel economy improvement of up to 18 percent with a concurrent improvement in acceleration performance. The acceleration level of this vehicle is superior to that of approximately 24 percent of General Motors' present passenger automobiles. DN–16, p. 2 (VW) and DN–18, p. 6 (GM). The fuel economy benefit from turbocharging is an indirect one which would typically result from the ability to substitute a smaller displacement engine for the larger one currently used and increasing the smaller engine's horsepower while maintaining its better fuel economy by turbocharging. Therefore, the performance reduction discussed above is adopted in the analysis on which the 1981–84 standards is based. See Rulemaking Support Paper, Section 5.3, for a further discussion of this topic.

3. *Improved automatic transmissions.* The Support Document projected that improvements in automatic transmissions could result in a 10 percent fuel economy improvement in vehicles which use automatic transmissions, or about 85 percent of the domestic fleet. This improvement was based on tests of prototype transmissions under contract for DOT, and several studies presented in papers submitted to the Society of Automotive Engineers. Id. Document 2, Vol. 1. These data indicate that improvements up to nearly 20 percent are achieveable with certain types of improved automatic transmissions. Present automatic transmissions are generally three-speed units with a conventional torque converter. Some data generated by the domestic manufacturers indicate that certain modified versions of the present three-speed transmissions, principally those employing a lock-up clutch on the torque converter in conjunction with a wide gear ratio range, have the potential to achieve the assumed 10 percent improvement. In addition, a four-speed, wide ratio range automatic transmission has the potential to achieve even greater fuel economy improvements, but at significantly higher costs. Ford, GM, and Chrysler each projected fuel economy improvements achieveable through the use of one or more of the above types of automatic transmission of a magnitude either consistent with or very close to the assumed 10 percent figure projected in the Support Document. DN–15, Doc. I, p. 3; DN–18, p. 3; DN–30, p. 11. Volvo also supported the 10 percent improvement projection. DN–28–02, p. 5. Even if the higher cost four-speed unit is necessary to achieve this improvement, none of the four domestic manufacturers claimed that the use of such units is economically impracticable, in response to a specific question in the April 1 special order. DN–7, Questions IIA and B. Indeed, Ford has begun plant modifications to permit the production of a four speed automatic transmission with lock-up torque converter in time for installation in some 1980 model year automobiles. Docket FE–76–01–GR–23. Therefore, the original 10 percent improvement is retained in the final analysis.

GM argued that the 10 percent improvement in automatic transmissions is not applicable to all automobiles which use automatic transmissions. DN–19, p. 3. Lightweight vehicles "with small displacement engines, small automatic transmissions and high axle ratios" are projected to attain a significant share of the market and, according to GM, the fuel economy of such vehicles is not significantly improved by the addition of a lock-up clutch. Id., p. 4. NHTSA cannot accept this argument for several reasons. First, GM addressed itself primarily to the impact of the lock-up clutch, without addressing the impact of increasing the number of geared speeds, which, as was previously noted, is considered both technologically feasible and economically practicable, or of other transmission improvement techniques. Second, none of the other manufacturers raised a similar objection to the assumed across-the-board application, despite their even greater orientation toward smaller market class automobiles. Third, it should be noted that General Motors" engineers have projected fuel economy improvements up to nearly 20 percent, over a wide range of engine sizes and axle ratios. See SAE Paper No. 770418, Docket FE–76–01–GR–21. It may be that GM is implying that its future use of a (presumably new) small automatic transmission with high axle ratio would obviate the need to use a lock-up torque converter on its small cars. If this is true, then the projected 10 percent improvement figure for all automobiles which employ automatic transmissions is still correct, since the new drive train would achieve that improvement. GM is in no way constrained to achieve that improvement in precisely the same manner in which it is postulated in this analysis.

AMC stated that it could only achieve a 2 percent improvement in its automatic transmissions. DN–14, p. 1. However, AMC presently purchases its transmissions from Chrysler and is likely to continue to purchase such technology from outside sources in the future. Therefore, any transmission improvements achieved by the "Big Three" would become available to AMC, albeit on a delayed basis. Implementation delays similar to those assumed for Chrysler and AMC for weight reduction were also assumed for transmission improvements in this analysis. See RSP Tables 5.5–5.8.

4. *Improved manual transmissions.* Another possible area of fuel economy improvement is the use of additional drive gears in manual transmissions. Many domestic manual transmissions have only 3-speeds. Information received on this subject in response to the April 1 (DN–7) and April 21 (DN–28) special orders supports a projected fuel economy improvement of 5 percent for the manual transmission portion of the fleet. DN–18, p. 8 (GM); DN–28–02, p.

6 (Volvo); DN–28–03, p. 5 (Honda). Ford's submission supports the feasibility of this substitution for all present manual transmissions. DN–15, Doc. I, p. 11. No information was submitted which raised any doubts about the technological feasibility or economic practicability of this option. In fact, five-speed manual transmissions have currently achieved substantial market penetrations in the import fleet. Honda projects that the use of five-speed manual transmissions would result in a $50 per vehicle price increase (for those vehicles with manual transmissions). DN–28–03, p. 5. Therefore a 5 percent improvement for all manual transmission vehicles was adopted in the analysis. The percentage of vehicles which use manual transmissions was not projected to increase between the present and 1985, due to the difficulty encountered by certain manual transmission vehicles in attempting to meet more stringent emission standards. The use of manual transmissions with additional drive gears results in a small, but nevertheless significant, increase in average fuel economy.

5. *Improved lubricants and accessories.* Improvements in average fuel economy can also be obtained through the use of synthetic, lower viscosity, or extended viscosity range lubricants and through improvements in the efficiency of vehicle and engine accessories such as pumps, fans, and accessory drives. A total improvement of 4 percent was assigned to these options in the Support Document, 2 percent for each category. See Doc. 2, Vol. I, p. 2–19. Three domestic manufacturers which addressed this issue did not object to the 4 percent improvement projection. DN–18, p. 1 (GM); DN–15, Doc. I, p. 3 (Ford); DN–14, p. 1 (AMC). Improvements up to the assumed 4 percent for lubricant improvements alone have been documented. See SAE Papers 750376 (Docket FE–76–01–GR–21) and 750675 (Docket FE–76–01–GR–21). Therefore, the assumed 4 percent improvement is retained in this analysis.

6. *Reduction of aerodynamic drag and rolling resistance.* Further fuel economy improvements are achievable through reducing the automobile's aerodynamic drag and rolling resistance. The latter term refers to the use of improved radial and other advanced tires and reductions in the frictional losses of bearings and other similar drive line and chassis components. Aerodynamic drag and rolling resistance improvements could be achieved in two ways. The first way is to obtain credit for aerodynamic drag reductions already achieved, through the use of the optional EPA "coast-down" procedure for determining road load dynamometer settings in fuel economy tests. See 40 CFR 86.177–11(e)(2). If the optional procedure is not used, fuel economy test results will be based on current tabulated values of road load power which in certain cases may result in deleterious fuel economy effects. The second way results from future improvement in these two areas. Credit for future aerodynamic drag reductions must also be obtained through the use of the optional EPA procedure. Data indicates that improvements in the first category alone can be of substantial magnitude. See RSP, App. D, Ref. 18.

The automobile manufacturers expressed a major difference of opinion on the magnitude of achievable improvements in this area. GM indicated that improvements up to 4 percent for aerodynamic drag and 4 percent for rolling resistance were achievable. DN–18 p. 5, 10, and ANPRM submission, Docket Number FE 76–01–N01, No. 10, pp. 16a, 21–24. The other manufacturers indicated much lower improvement potential, although apparently not assigning a high research and development priority to these items. DN–14, pp. 4, 5 (AMC); DN–19, p. 3, DN–32, Att. II, (Chrysler); DN–15, Doc. I, p. 11 (Ford). As was frequently the case with the manufacturers' statements, the percent improvements given reflect present plans as opposed to maximum capabilities. Therefore, the Department conducted an investigation to determine which of the disparate projections most closley corresponded to the actual maximum feasible improvement. Available data indicates that improvements in the upper range of GM's projections are in fact feasible for the 1981–84 time period. Volkswagen, for example, has demonstrated how relatively minor changes to automobile exterior design can result in significant reductions in aerodynamic drag, even beyond the GM projections. SAE Paper No. 760185, Docket FE–76–01–GR–21. Methods for reducing aerodynamic drag are discussed further in Appendix D of the Rulemaking Support Paper.

In the case of rolling resistance, it appears that a 5 percent fuel economy improvement can be obtained by switching from bias tires to "first generation" radials, although much of the switching has already occurred. "Second generation" radials which will offer further improvements of 2 to 4 percent are now under development, with GM apparently being the leader in this area among the auto companies. Docket FE–76–01–GR–19, 20, 22. It should be noted that developments in this area will result from the automobile companies working together with the tire manufacturers, since the automobile companies generally do not manufacture their own tires. It is likely that major breakthroughs by one automobile manufacturer would soon become available to all manufacturers, since the tire company which produces the improved tire could market that tire freely. Additional rolling resistance reduction can be obtained through increasing tire inflation pressures while making appropriate changes in the vehicle suspension system. See Appendix D of the Rulemaking Support Paper for further information on reducing rolling resistance. It is concluded that the previously discussed improvements in each of these two areas are feasible in the 1981–84 time frame, on a gradual phase-in basis. See RSP, Tables 5.5–5.8.

7. *Use of alternative engines.* The present fleet of domestically manufactured passenger automobiles is powered exclusively by conventional homogeneous charge spark ignition gasoline engines. However, certain alternative engine types such as the diesel and such stratified charge concepts as the Honda CVCC and the Ford PROCO (programmed combustion) offer the potential for significantly better fuel efficiency than present engines. Many manufacturers plan to use some form of alternative engine in their domestic fleets in the near future, including General Motors with the diesel (DN–18, p. 32), Ford with the PROCO (DN–15, Doc. I, p. 2), and Chrysler with a form of prechamber engine (DN–35–01, Attachment B, p. 6), in addition to the Honda CVCC and Mercedes, VW, and Peugeot diesels aleady on the market. In the case of the diesel, the Support Document projected (Summary Report p. A39), and the domestic manufacturer most actively pursuing the development of diesel engines confirmed in its response to the April 1 special order, that the diesel offers 25 percent better fuel economy than a comparably performing conventional spark ignition engine. DN–18, p. 2 and Attachment V (GM); DN–7, Question I.A. In addition, Volvo supported the 25 percent figure. DN–28–02, p. 4. Ford indicates that the PROCO engine can be expected to provide an improvement in fuel economy of approximately 20 percent. DN–15, Doc. I, p. 3 and Tr–II, p. 38. Honda projects a fuel economy improvement differential of roughly 10 percent for its CVCC engine. DN–28–03, p. 11. This projection may be low. The fuel economy difference between its CVCC and non-CVCC versions of the Civic, as determined in EPA fuel economy tests is approximately 30 percent. The Support Document's projection of a 25 percent improvement in fuel economy for the diesel was based on a comparison of fuel economy differentials actually experienced by GM and VW with their recently certified diesel passenger automobiles.

A number of objections were raised by a variety of participants in the proceeding with respect to the Department's original projections of a market penetration for diesels in the passenger automobile fleet growing linearly from 5 percent in 1981 to 25 percent in 1985. The passenger automobile industry argued that the primary difficulties in achieving those substantial market penetrations involve questions about the marketability of diesels and the ability of diesel engines to meet stringent nitrogen oxides emission standards. Tr–II, P. 105, 126, (GM); DN–19, p. 1 (Chrysler). The marketability problem for diesels is attributed to their higher initial cost and current problems with exhaust smoke, engine noise, cold-starting, fuel availability, and odors. The nitrogen oxide problem results from the diesel's alleged inability to achieve nitrogen oxide standards as low as 1.0 gram-per-mile, the level specified in the Senate and House versions of the Clean Air Act amendments. On the other hand, representatives of some public interest groups argued that the most serious problem with the diesel engine is that it emits certain presently unregulated, but nevertheless dangerous, pollutants such as

particulates and polynuclear aromatics (PNA) and that increased use of diesel engines should therefore be pursued with caution. DN–12, pp. 19–28 (Citizen's for Clean Air); Tr–I, p. 93 (Dr. Sawyer, for Environmental Defense Fund).

In order to obtain more information on the marketability of diesel engines, the Department, in the April 1 special order, required those passenger automobile manufacturers most actively pursuing the diesel option to submit copies of any surveys in their possession relating to the marketability of diesels in the United States. DN–7, question IV. A (GM) and question B (VW). These surveys tended to support the conclusion that a 20 to 25 percent market penetration is potentially achievable. DN–18, Att. IV. It appears that the initial orientation of present passenger automobile buyers toward diesels is improved significantly when potential buyers obtain more information about the diesel's characteristics. In addition, present consumer resistance to diesels is based on perceptions of those diesel vehicles presently on the road. GM reports that "(r)ecent developments have significantly improved some of the factors that have historically detracted from the market acceptance of diesel engines such as noise, odor, cold start time and reduced acceleration." DN–18, p. 2. See also DN–16, p. 1 (VW), with respect to the turbocharged diesel Rabbit. Further improvements in diesel performance can be anticipated as the use of diesels is expanded. Therefore, marketability of diesel engines does not at this time appear to be as serious a problem as the manufacturers have indicated, although questions of the precise extent of future market penetration remain.

Similarly, the nitrogen oxides emission problem does not appear to be beyond solution. Relatively little has been done in the area of research on control of diesel emissions because of their present low market penetration and their ability to meet present emission standards essentially without emission controls external to the combustion chamber. In small diesel passenger automobiles, such as the VW Rabbit, NO_x levels either meeting or closely approaching a 1.0 gram-per-mile standard have been achieved without the use of such NO_x control techniques as exhaust gas recirculation. Tr–III, p. 11. In larger automobiles, GM states that a level of 1.5 grams-per-mile of NO_x is achievable with its 350 V–8 diesel. Tr–II, p. 127. Further, both the recently passed House and Senate amendments to the Clear Air Act provide for some type of NO_x waiver for diesel engines. Ford states that its PROCO alternative has the capability to achieve the 1.0 NO_x standard without encountering the unregulated pollutant problems to the same extent as diesels. Tr–II, pp. 36, 42. The Honda CVCC approach appears to offer significantly better emission control potential than the homogeneous charge engine, without associated unregulated pollutant problems. DN–28–03, Attachment, p. 100. Therefore, the Department has concluded that control of NO_x emissions down to approximately 1.0 gram-per-mile will not present an insurmountable barrier to the increased use of alternative engines, although further development work may be required. See Tr–I, p. 93, (Dr. Sawyer).

The magnitudes of the problem presented by the unregulated pollutants emitted from the diesel and the PROCO and of the potential for reducing those emissions are presently unclear. The particulate emissions from diesels are of concern to EPA because of the potential significant contribution to air quality control regions' particulate problems. EPA is studying the total mass and other aspects of diesel particulates, but as yet no firm guidelines on allowable diesel particulate emissions have been set. Control of diesel particulates, if needed, is expected to be a formidable technical task. See Docket Number FE–76–01–GR–17.

For the reasons specified above, and particularly because the Department desires further information on health effects the Department has not included alternative engines in the analysis forming the basis for maximum feasible average fuel economy projections. The foregoing disposition of the "alternative engine" issue does not preclude the Department from including the use of such engines in projections of maximum feasible average fuel economy in a subsequent proceeding to amend the 1985 standard.

One final point with respect to future use of the diesel engine deserves further discussion. Up to the present, the use of diesel engines has generally been confined to luxury automobiles such as the Mercedes and Peugeot. Recently Volkswagen and General Motors have begun implementation of that engine by dieselizing an existing engine, rather than designing a completely new engine. In view of past applications of the diesel engine, it would not be surprising if the new dieselized versions of the VW and GM engines were marketed as luxury items at a high price mark-up, higher than that justified by the additional cost alone. If this were done, this fuel efficient technology might not get the fair market test which it deserves, because of the high price differential.

Volkswagen has not adopted this approach. Rather, it has offered its diesel engine as a $170 option in the Rabbit (Tr–III, p. 18), and all indications are that the diesel version is selling extremely well, both in the United States and in Europe. Persistent rumors have circulated that the General Motors diesel would be offered at an extremely high mark-up, of up to $1,000. Tr–II, p. 110. This would raise serious questions as to the adequacy of the market test which the GM diesel would receive, if those rumors are in fact true. See TR–II, p. 111 (GM). Despite the differences in size between the VW and GM engines, the Department would be hard pressed to understand such a large price difference between the two engines. See Support Document, Doc. 3, App. B.

8. *Improved spark ignition engines.* The Support Document projected that a fuel economy improvement on the order of 10 percent is achievable through improvements to the conventional spark ignition engine. The use of an integrated electronic control unit for spark advance, fuel metering, and exhaust gas recirculation, optimization of combustion chamber, intake system, and valve timing, and the use of knock sensing and fuel injection were identified as methods for achieving the improvement. See Support Document, Doc. 2, Vol. I, pp. 2–16, 3–7. The percent improvement attributable to each of those options was not specified, although it was stated that 2 percent of the total was assigned to fuel injection, with the remaining 8 percent divided among the others. Id., 3–7.

The Support Document also identifies other spark ignition engine improvements that could occur as a result of that Document's downsizing methodology. As vehicles were downsized, smaller engines were projected to be used in those vehicles, in order to maintain horsepower-to-weight ratios. However, in selecting among a manufacturer's existing engine line, it was anticipated that in those cases where a choice among existing engines was possible, the manufacturer would select the more efficient one and phase out the least efficient. This procedure would result in an improvement in average engine efficiency of 8 to 13 percent. See Support Document, Doc. 2, Vol. 1, p. 3–8.

The Support Document noted further that several of the technological changes to engines for fuel economy improvement might also be used to control engine exhaust emissions. The dual benefits of such engine and emission control technologies is explicitly recognized. It is necessary to avoid double counting of benefits, however, and since the automobile companies and the Environmental Protection Agency (EPA) have generally treated the electronic control unit as part of the emission control system, this analysis is revised accordingly to make it consistent. DN–18, p. 20 (GM); DN–15, Doc. I, p. 17 (Ford); "Analysis of Alternative Motor Vehicle Emission Standards," Docket FE 76–01–GR–17, App. A. Therefore, no separate fuel economy benefit was attributed to the use of electronic control units.

The 2 percent fuel economy improvement assigned to fuel injection was confirmed by Ford, and no participant in the proceeding suggested a lower number. Id., Doc. I, p. 17. Bendix, the major domestic manufacturer of these units, claimed a 15 percent fuel economy benefit, adjusting for comparable emission and horsepower levels. DN–27B, p. 2. Bendix projects the costs of the unit, including the previously discussed electronic control unit and sensors, to be less than $100, about $15 more than the advanced carburetor it would be likely to replace. Several model types now in production employ fuel injection. See 1977 EPA/FEA Gas Mileage Guide.

It appears likely that the precise improvement achievable through the use of the remaining engine improvement techniques will vary from manufacturer to manufacturer, depending on the effi-

ciency of engines presently in use. AMC expressed "no disagreement" with the originally assigned improvement, which was 10 percent. DN–14, p. 1. Chrysler projected up to a 3 percent fuel economy improvement for redesigned cylinder heads, and a total of 7½ percent for engine control optimization. DN–30, 10, 44. Ford did not address the issue except for the impact of electronic control unit.

Therefore, it appears that a fuel economy improvement ranging from 2 to 10 percent, depending on the manufacturer, is achievable by improvements to spark ignition engine efficiency, even beyond that associated with the use of the best of present engines. In the case of the manufacturers with the most efficient engine lines, the 2 percent fuel injection benefit would be available, as a minimum, since present domestic automobiles use that technology only to a negligibly small extent. In the case of the manufacturers with the least efficient engines, even selecting the most efficient engines in their lines would not result in the application of optimally efficient engines. Further techniques would be available to those manufacturers to achieve up to the 10 percent improvement in fuel economy projected in the Support Document.

The Department's assessment of the fuel economy improvements due to improved engines in 1981–1984 is that the detailed matching of specific engines with vehicles in specific inertia weight classes as identified in the Support Document is valid, and that the various engine and emission control technologies discussed above can be used to maintain the fuel economy resulting from that matching process while emission standards are tightened. See Section III. C., however, for further discussion of the relation between fuel economy and emission standards.

A specific engine efficiency improvement device not included in the previous discussion is the variable displace ment engine. This concept involves the use of an electromechanical system which deactivates some of the engine's cylinders during those operating modes which require less power, such as idle, light acceleration, cruising and deceleration. Eaton Corporation, the developer of this technology, projects fuel economy improvements of 10 to 40 percent with its units, depending on the engine operating mode. Some fuel economy benefit would accrue during all operating modes except moderate to heavy acceleration. Ford, which is the automobile company most actively pursuing the implementation of this technology, cites fuel economy benefits to date of 3 to 7 percent on the EPA composite driving cycle. DN–15, Doc. 1, p. 17. It should be noted that this technology has been applied to certain prototype alternative engines, in addition to conventional engines. TR–II, p. 39.

9. *Building "captive imports" domestically.* Section 503 of the Act provides that for purposes of determining compliance with fuel economy standards, the fuel economy ratings of domestically manufactured automobiles may not be averaged after model year 1979 together with automobiles more than 25 percent of whose cost is attributable to value added outside the United States and Canada. Ford, GM, and Chrysler each have subcompact passenger automobiles which fall in the latter category. Thus, if those "captive import" passenger automobiles were manufactured in the United States in the future, they could be included in those manufacturers' averages, resulting in some increase in that average. All three manufacturers disclaimed having present plans to do this, but none claimed this to be infeasible. Therefore, this also presents a possible method for complying with the fuel economy standards, while concurrently increasing domestic employment.

Volkswagen has noted that this provision has the anomalous effect of discouraging a foreign manufacturer from building production facilities in the United States. While it was adopted to prevent an exportation of jobs, the provision, as applied to a foreign manufacturer, discourages the importation of jobs. Although this impact may well not have been intended by Congress, it follows directly from the statutory language and the Department is powerless to change the result administratively. However, Volkswagen, or any other foreign manufacturer, may manufacture automobiles in the United States as long as more than 25 percent of the value added content is foreign, and still average those vehicles together with their imported fleet.

10. *Mix shifts.* A significant fuel economy benefit can be achieved through the use of marketing strategies to increase the sales of smaller automobiles. In addition, some improvement can result from mix shifts even in the absence of any initiatives by the manufacturers, if increases in demand for the smaller market class automobiles can be projected. Such a trend is projected by Ford and Chrysler, relying in part on long-term trends toward the smaller market classes. TR–II, p. 270 (Chrysler) and DN–15, Doc. I, p. 11 (Ford). See also TR–I, p. 89 (Dr. Sawyer), DN–13, p. 4 (Environmental Defense Fund), and DN–21, Attachment (Public Interest Economics Foundation), the latter with respect to the issue of the feasibility of "forcing" mix shifts.

Ford argued that requiring the manufacturers to take actions to shift the mix of passenger automobiles away from that mix which would result from "free market" forces is beyond the Department's statutory authority. DN–15, Doc. IV, p. 3–8. The Department rejects this position as inconsistent with the "maximum feasible" requirements and the legislative history of the Act.

The legislative history of S. 1883, the Senate version of the fuel economy provisions, contains a clear indication of the Congressional intent with regard to the role of market forces and mix shifts in establishing the standards. In explaining the standards set in the bill, the Senate Commerce Committee stated:

> A DOT/EPA report estimated that up to a 63-percent improvement in new car fuel economy could be achieved by 1980. This 63-percent gain was based upon maximum technological improvement through 1980 (weight reduction, aerodynamic drag reduction, transmission improvement, engine resizing and optimization) and a moderate shift in sales mix to 35 percent large and intermediate cars, and 65 percent compact and subcompact cars. Such a shift is within the current capability of the auto industry. By calling for a 50-percent improvement, this legislation provides ample cushion for unforeseen contingencies.

S. Rep. No. 94–179 (94th Cong., 1st Sess.) at 10. The Committee thus seems to have implicitly accepted the necessity or propriety of requiring such a mix shift to achieve the standards it set. In selecting a 50 percent instead of 63 percent improvement, the Committee did not reject any particular identified means of improving fuel economy. It simply provided a cushion against all types of contingencies. One contingency would be the failure of the assumed mix to sell. Another would be the failure of technology to develop at the assumed pace or to yield the anticipated improvement. The Committee's acceptance of the shift is made even clearer a few pages later in the Report:

> Figures obtained from the Recreational Vehicle Industry Association indicate that there will be approximately 2 million travel trailers (homes-on-wheels) and 1.2 million camping trailers (fold-down types) in the hands of the American public in 1976. There are also 3.2 million families in the United States of 7 or more persons. If reasonable assumptions are made about yearly growth in the number of trailers, auto fleet turnover rates, etc., a conservative estimate of the towing and large family demand for big cars is something under 1 million per year over the next few years. Even if the most drastic sales mix shifts necessary to meet the 1980 goal occur, there will still be at least 1 million full size and luxury cars produced, clearly a sufficient number to meet the demand. Special problems could arise in the 1980's if the automakers insist on sticking solely to the internal combustion engine to meet the 1985 goal. However, diesel towing packages could be an answer to this problem, with no sacrifice in fuel economy. Also, light duty trucks, which are not subject to the 1980 or 1985 goals could meet a significant portion of towing demand.

Id. at 14. The Committee clearly anticipated shifts in both sales mix and the type of vehicles offered for given uses. The 1 million figure was apparently obtained by multiplying the 10 percent large car figure used in the mix shift assumed in the DOT/EPA report and 10 million, the total number of passenger automobiles sold annually in the mid-1970's.

The extent of the sales mix shift the Committee contemplated as being possibly required to meet the 27.5 mpg standard, and the means that would be necessary to achieve it, are apparent from the DOT/ETA report cited by the Committee. The potential 63 percent improvement was under "Scenario D", which required:

> Steady technological improvement through the 1980's * * *
> * * * with 1980 sales mix assumed at 10 percent large cars, 25 percent intermediates, 25 percent compact, and 40 percent subcompact.

Potential for Motor Vehicle Fuel Economy Improvements: Report to the Congress, U.S. Department of Transportation and the U.S. Environmental Protection Agency, October 24, 1974, at 66. The DOT/EPA report also states that:

> • • • sales shift in Scenario D would probably not occur "voluntarily" because of market demands for larger cars, i.e., Scenario D would probably require more substantial government pressure on manufacturers and/or consumers than would be the case under Scenarios B and C.

Id. at 64, and that;

> Shift in mix was limited to that possible given the availability of production facilities, but no limitations due to consumer demand were assumed. Some of the technological options considered require further development; however their implementation is deemed feasible by 1980. Technological options were screened for consumer acceptability prior to their inclusion, but once selected, eventual 100 percent application to the new car fleet was assumed.

Id. at 4. The Committee thus explicitly recognized that major shifts in sales mix could be required to meet the standards and implicitly recognized that these shifts might not result voluntarily but could require government pressure on the manufacturers and/or consumers. The only limit on the mix shift that was contemplated was that which was imposed by the availability of production facilities; consumer acceptance was considered only with respect to technological improvements.

The Senate Committee apparently realized that this process would not be without some risks. First, as stated above, it reduced its standard to require only a 50 percent increase, rather than a 63 percent increase, to provide "ample cushion for *unforeseen* contingencies." (emphasis added). Second, the bill itself contained provisions to protect the manufacturers from an "unanticipated retail sales mix" beyond the control of the manufacturer in section 508(b)(3):

> "(3) The Secretary may waive or modify a civil penalty determined under subsection (a)(1) of this section if, and to the extent that the manufacturer involved demonstrates to the Secretary that its failure to comply with an applicable average fuel economy performance standard resulted from an unanticipated retail sales mix among different classes of automobiles or light duty trucks, as appropriate, manufactured by it and that such mix was beyond the control of the manufacturer: *Provided*, That the Secretary may not waive or modify any such penalty unless the manufacturer involved demonstrates to the Secretary that it included in its automobiles or light duty trucks, as appropriate, all of the improvements to increase fuel economy that were technologically feasible, and that it made a good faith effort to produce or stimulate a retail sales mix that would have resulted in compliance with the applicable standards, through advertising, pricing practices, availability of models, and any other means.

In other words, a manufacturer could be let off, but only if it had done everything it could to achieve the required product sales mix.

Finally, the bill provided some additional protection for the manufacturers by allowing for recoupment of penalties in the event of subsequent overachievement (section 508(c)) and for modification of the standards by the Secretary if new information indicated the standards could not be achieved (section 504(b)). It should be noted, however, that downward revision of the 1980 and 1985 standards would be subject to Congressional approval (section 504(b)(2)).

To summarize briefly, the Committee apparently recognized that a major sales mix shift away from current levels would be necessary to meet the standards, and that achieving this shift would require pressure from the government on the manufacturers and by the manufacturers on the consumers. It realized there were risks involved in this, and tried to reduce them first by setting the standards below the maximum achievable level, and then by allowing an escape clause for the manufacturers if the consumers did not accept sales mix necessary to meet that reduced level after every good faith effort to change their preferences. Finally, it provided a mechanism for recoupment of penalties, and for revision of the standards downward, subject to Congressional approval, if the standards could not be met.

There is only one statement in the report which could be claimed to limit this virtual requirement of significant sales mix shifts:

> The fuel economy standards approach adopted in this legislation leaves maximum flexibility to the manufacturer to meet the standards. This should result in a more diverse product mix and wide consumer choice. In meeting the fuel economy standard applicable to any given model year one manufacturer could choose new technology, another could choose to shift more rapidly to lighter weight vehicles, and still another could choose some combination of the two.

S. Rep. No. 94-179, supra, at 6. Arguably, the "more diverse product mix" language limits the extent to which any mix shift could be pushed. However, this argument must be rejected because the language already states that the standards adopted in the bill, which include the significant mix shifts, will satisfy this concern. Rather than limiting the magnitude of the mix shifts necessary, this language seems to indicate that the approach of letting each manufacturer choose its own approach to meeting the standards will result in a more diverse product mix than the alternative legislative solutions that were considered, such as mandating the procedures to be used or forbidding the sales of vehicles getting below a specified fuel efficiency rating.

The legislative history of H.R. 7014, the bill containing the House version of the fuel economy provisions, is less specific in its treatment of product mix and market demand. The first references were in regard to the process of setting the 1980 standards:

> The DOT-EPA study of the potential for motor vehicle fuel economy improvement indicates that with technological improvements and use of smaller engines but without any shift to smaller cars, sales-weighted fuel economy of automobiles sold in 1980 could reach 20.3 MPG in 1980 (a 45 percent increase above 1974). If the maximum feasible shift to small cars occurred, sales-weighted fuel economy could reach 22.2 mpg in 1980 (a 50 percent increase over 1974). The study assumed, for purposes of these projections, that these levels of fuel economy could be achieved without any reduction in the stringency of the statutory hydrocarbon (HC) and carbon monoxide (CO) emission standards which are scheduled to be effective in 1978.

H.R. Rep. No. 94340 (94th Cong., 1st Sess.) at 86, and

> The Committee, in setting the statutory average fuel economy standards for passenger automobiles, gave careful consideration to the EPA-DOT study's conclusion that a 63 percent improvement in average fuel economy levels between 1974 and 1980 (22.2 MPG) was the maximum potential improvement in average fuel economy. This projection was on an industry-wide basis and was not a level which each manufacturer necessarily could be expected to reach; it assumed the maximum shift to smaller cars which was technologically feasible, and it appeared to assume that there would be no reduction in fuel economy associated with more stringent emissions standards. The Committee, in translating this industry-wide potential average fuel economy projection into an average fuel economy standard which each manufacturer must attain, was of the view that any emission standards likely to be in effect in 1980 would involve at least a 5 percent reduction (1 MPG) in average fuel economy in 1980. In addition, because of the likelihood that in that year a number of smaller manufacturers are likely to "overachieve" (have an average fuel economy in excess of the industry-wide target), the Committee felt it could set a standard for each manufacturer which was somewhat lower than the industry-wide target. In light of these considerations the Committee set the average fuel economy standard for each manufacturer at 20.5 MPG for model year 1980. The model year 1978 and 1979 standards were set at 2 MPG and 1 MPG, respetcively, below the 1980 standard.

Id. at 88.

Taken together, these two passages leave no doubt that the Committee based its standards on the improvement projection that included the significant product mix shift, as discussed above, and thus also implicitly accepted the possibility that mix shifts would be required to meet the standards. Id. at 87. This seems particularly clear from the second statement. The Committee started with one figure and made two adjustments in it to obtain the standard specified in the House bill. Since the starting figure was based on the mix shift assumed in the DOT-EPA report and since neither of the adjustments involved elimination of the mix shifts, the final figure must be based upon those shifts too.

The only other mention of product mix or consumer demand is the following:

> • • • Committee recognizes that the automobile industry has a central role in our national economy and that any regulatory program must be carefully drafted so as to require of the industry what is attainable without either imposing impossible burdens on it or unduly limiting consumer choice as to capacity and performance of

motor vehicles. The Committee has devised the regulatory program, which appears in Part A of the bill, * * *

Id. at 87. Again, it is arguable that the "without . . . unduly limiting consumer choice" language could limit the extent of any market shift. However, it is again clear that the Committee believed that the program it had proposed would satisfy this constraint, i.e., that the mix shifts contemplated by the standards would not unduly limit consumer choice. Further, this passage proscribes only "*unduly* limiting consumer choice". (Emphasis added.) That is, consumer choice may not be limited unless it can be justified by resulting improvements in fuel economy.

Finally, the House bill did not contain any provisions allowing modification of any penalties incurred because of unanticipated sales mix. However, the bill contained provisions allowing both the carry-back and carry-forward of penalty credits for overachieving in any model year (section 508(a)(3)) and modification of the standards, subject to Congressional disapproval for decreases below 26 mpg or increases above 27.5 mpg.

The legislative history indicates that both houses of Congress expected that significant shifts in product mix might be required to meet the standards they were setting, and that there would have to be some efforts to induce the market to achieve these shifts. The manufacturers have a panoply of marketing measures, including, pricing, advertising, and dealer incentives, to aid them in such efforts. Both houses of Congress provided some mechanism for reducing penalties if the standards could not be achieved, with the Senate specifically providing for the effects of a failure of a manufacturer to succeed in inducing the market to accept the required mix.

The Act as finally adopted does not contain the Senate unanticipated mix provision, but is basically identical to the House bill in its penalty recoupment provisions. The fact that the Senate provision was eliminated may indicate either that a tougher standard was finally agreed to by the Senate, or that the recoupment and standard modification procedures were believed adequate to handle failures to achieve required product mixes. What is clear is that free market demand and product mix were in no way determinative of the standards finally adopted. If consideration of non-free market mix shifts is appropriate in establishing the 1980 standard, it must also be appropriate for the 1981–84 standards, which are required to result in "steady progress" over the 1980 base toward the 1985 target.

11. *Combining the improvement projections.* To determine the technologically feasible level of average fuel economy for each of the domestic manufacturers, it is necessary to combine the percent improvements assigned to each of the technological options discussed in section III.A, according to the phase-in schedule set forth in Tables 5.5–5.8 of the RSP. The methodology in the Support Document assumed (Doc. 2, Vol. I, p. 2–23), and the manufacturers did not seriously dispute, that the improvement options, including weight reduction, transmissions, engine improvements, and alternative engines could be combined in a straight-forward arithmetically additive manner. Question I.D. of the April 1 special order directed the automobile manufacturers to specify which, if any, of the options for improving fuel economy are not additive, to quantify any negative synergistic effect, and to submit any data relevant to this issue. GM responded that the options it had evaluated are additive. DN–18, p. 11. Ford presented a table showing areas of judged incompatibility between various options but presented no supporting data or rationale. DN–15, Doc. I, p. 14. Most of the areas of questionable additivity involved alternative engines. Chrysler expressed the opinion that the various options are either "additive or very nearly additive" and stated that it relied on the assumption of additivity for its own internal projections. DN–32, p. 12. Chrysler expressed uncertainty about the options related to engine speed, such as some accessory improvements and overdrive transmissions, but was unable to quantify this effect. Therefore, the assumption of additivity has been retained. Options which are mutually exclusive, such as improved automatic and manual transmissions, are of course not additive.

Based upon the technologically feasible weight reduction only, the Department projects that General Motors, Ford, Chrysler, and American Motors will be able to achieve 21.6 mpg, 21.6 mpg, 22.7 mpg, and 21.2 mpg, respectively, by 1981, and 22.2 mpg, 23 mpg, 23.6 mpg, and 24.7 mpg, respectively, by 1985. The following additional average fuel economy gains can be achieved through the use of the other technological options:

TABLE 1

	Percent
Acceleration reduction	10
Automatic transmission with lockup torque converter	10
Five-speed manual transmission	5
Improved lubricants	2
Reduced accessory loads	2
Reduced aerodynamic drag	4
Reduced rolling resistance	3
Diesels (or equivalent alternative engine)	20–25
Further weight reduction (additional material substitution and further downsizing, including front wheel drive)	5
Improved spark ignition engines	2–10
Variable displacement engines	3–7
Turbochargers	0–15
Domestic production of captive imports	0–4
Mix shift to 10 pct large, 25 pct intermediate, 25 pct compact, and 40 pct subcompact	5

B. *Economic practicability.* In considering the economic practicability of implementing the technologically feasible options in 1981–84, the Department examined several different schedules of standards based upon different sets of options. The sets ranged from one that was almost fully comprehensive to one that included only a select number of the options. Excluded from all sets were some spark ignition engine improvements, variable displacement engines, further weight reduction beyond that initially projected in the Support Document or submitted by the manufacturers, and domestic production of captive import passenger automobiles. Due to the lack of complete data for these options and their omission from the NPRM and Support Document, they have been excluded from further consideration in this rulemaking. Efforts will be made to supplement the Department's data base in these areas in future rulemaking proceedings.

The least comprehensive set was that underlying the schedule of standards suggested by Ford: 21 mpg in 1981; 22 mpg in 1982; 23 mpg in 1983; 24 mpg in 1984; and 25 mpg in 1985. Even though that was the highest schedule suggested by any manufacturer, the Department regards it as a low range schedule. It was rejected for several reasons. First, it would not satisfy the maximum feasible requirement. The manufacturers have available to them options that involve little or no engineering or marketing risk that in combination would be economically practicable and would enable them to exceed substantially Ford's suggested schedule. Second, the schedule would violate the requirements that the 1981–84 standards result in steady progress toward the 1985 standard which, unless changed by future rulemaking, is 27.5 mpg, not 25 mpg.

The Department also considered a high range schedule based on all of the options not excluded in the first paragraph of this section.

The Department believes that there are risks associated with substantial mix shifts notwithstanding the historical trend toward smaller passenger automobiles. While that trend may continue, there is no assurance that it will. For reasons including prestige, comfort, and sheer size, there continues to be a strong demand for mid size and large size passenger automobiles. This is true even though most of these automobiles offer no more seating capacity in terms of number of positions than some compacts. Further, as discussed below, the downsizing of passenger automobiles may at least temporarily slow the trend to small cars. Further, the Department lacked sufficient marketing data to justify a lesser shift toward small cars.

Given the overriding purpose of the fuel economy provisions in the Act to conserve fuel, the Department was concerned that the standards be set as high as possible, but not so high as to necessitate the manfacturers' using compliance methods that would result in a substantial sales drop. To the extent that the total passenger automobile population fails to turn over and renew itself at the usual pace because some owners retain their existing vehicles for an extra year or two, the projected fuel savings from a given fuel economy standard would not be fully realized. In addition, a substantial sales drop would have a significant effect on employment in the

automobile and related industries and would adversely affect the manufacturers' efforts to raise capital for further fuel economy improvements. See RSP, Chap. 13, Reference 27, Section E.

The Department concluded that the implementation of the schedule of standards resulting from this set was not economically practicable due to the risk posed by substantial mix shifts that a significant number of consumers might defer purchasing new passenger automobiles in 1981–84. Further, implementing all of the options in this set would result in levels of average fuel economy above those permitted under the steady progress requirement, since the 27.5 mpg level would be exceeded prior to 1985.

The Department is also concerned about the possible adverse environmental impacts associated with some alternative engines, notably the diesel. As discussed above, several commenters pointed out that particulate and PNA emissions of these engines may pose a health hazard. If the existence of a health hazard is confirmed by the Environmental Protection Agency, then regulation of those emissions will presumably follow. The stringency of those regulations and their effect on the fuel economy of the alternative engines is indeterminate at this time. As information from that agency and other sources clarifies this question, the Department will begin to consider whether to base fuel economy standards on the use of those engines.

For all of the foregoing reasons, the Department decided not to set the average fuel economy standards so high as to necessitate the use of all options within the limited period of 1981–84.

The Department also considered a medium range schedule of standards based on a less comprehensive set of technological options from which alternative engines and mix shifts had been excluded. In excluding these options as bases for determining the fuel economy standards under this set of options, the Department was particularly mindful that there will be substantial changes in passenger automobiles in the early 1980's due to changes in fuel economy and emission standards. In a later period of less product design and technological flux, the risk associated with mix shifts and alternative engines would be lessened.

The Department regards mix shifts and alternative engines, as well as the options excluded from the high range set of options, as constituting a safety margin for the manufacturers that choose to implement the medium range options to the extent set forth below. If the latter options do not yield the anticipated gains, despite the conservative assessments of those gains, the manufacturers may avail themselves of options in the safety margin. For manufacturers which do not wish to implement the medium range collection of options in the amount described below, these additional options represent alternative options which they can utilize. The Department notes that virtually every option excluded from the high or medium range sets of options will be used by at least one manufacturer and some by several. To the extent that these options are used, the manufacturers will not have to rely so much on the collection of medium range options. Further, all manufacturers can use marketing measures to encourage the purchase of the most fuel efficient vehicles within each carline.

The schedule for implementation of the various middle range technological options or improvements, which are set forth in Tables 5.5–5.8 of the RSP, reflect the differences in economic capability of the various domestic manufacturers. That implementation schedule is in no case more stringent than that in the NPRM Support Document. See Document 2, Volume 1. None of the manufacturers claimed that the proposed implementation schedule is impracticable. However, objections to specific cost assumptions in the Support Document were submitted by some manufacturers. Since these cost numbers affect the projected sales, employment and inflationary impacts of the standards, and thereby economic practicability, these objections have been carefully reviewed. However, the vagueness and unsubstantiated character of the assertions in the manufacturers' comments have impaired the usefulness of the submitted information, here as in the case of the technological issues discussed in section III.A.

General Motors, Ford, and Chrysler all objected to the projected capital investment requirement for downsizing of $150–250 million for an annual production capacity of 400,000 automobiles. All stated that this figure was about half the correct amount. DN–18, p. 18 (GM), DN–43, Att. II, p. 2 (Ford), and DN–30, p. 53 (Chrysler). Therefore, and in view of the fact that GM and Ford already have had substantial experience with implementing this technological option, the capital requirement for downsizing was revised to the $400 million figure. GM and Chrysler both objected to the variable cost savings of $200 assigned to downsizing, but neither submitted a different figure or a detailed critique of the Department's analysis. Ford's discussion of the savings resulting from the introduction of a new, small, future car line is consistent with the Department's assumption, when weight reduction and concurrent product improvements are separated. DN–43, Att. II, p. 3. Therefore, the originally projected savings in variable cost was retained. Chrysler's unquantified objection to the maintenance cost figure is also rejected. The Department's further evaluation of data supporting the original projection of a 35 cents/pound maintenance cost saving reaffirms the original conclusion. See Support Document, Summary Report, p. R–2, #3.

GM, Ford, and Chrysler raised similarly vague objections to the projected capital and variable costs attributable to material substitution. DN–18, p. 19; DN–43, Att. II, p. 4; DN–30, p. 54. Nevertheless, Chrysler conceded that the use of high strength steel would have no appreciable effect on variable costs. Detailed cost information on the use of aluminum and high strength steel was submitted by Alcoa and U.S. Steel Corporation, respectively. DN–27–D, DN–27–A. Both submissions supported the Department's original conclusion about the cost of light-weight material substitution. If components are selected from the lists of feasible material substitutions provided by these two companies, it is possible to achieve the weight reductions projected in the Support Document without increasing variable costs. Further weight reductions could be achieved at slightly higher cost. Similar objections were raised to cost savings attributable to reduced maintenance. However, as noted above, the Department's further study in this area fully supports the Support Document's projected relationship between weight reduction and reduced maintenance expense. This savings results from, as one example, the ability to use smaller tires on lighter automobiles, thereby reducing replacement costs. GM failed to quantify or substantiate its claim that the lighter weight substitute materials would be more damage prone than present materials, DN–18, p. 22. The Department's analysis, together with the Alcoa and U.S. Steel submissions, supports the achievability of the assumed weight reduction by careful matching of a particular substitute material to the particular application desired. Furthermore, GM failed to address the savings associated with the improved corrosion resistance of aluminum or plastic substitutes. DN–27D, p. 2 (Alcoa). Therefore, the original maintenance costs savings estimate has been retained.

The costs associated with improvements in such areas as lubricants, accessories, aerodynamic drag reduction, and rolling resistance reduction are as set forth in Table 7.1 of the Rulemaking Support Paper. No contradictory information was submitted on these costs, in response to a specific question in the April 1 and April 21 special orders. DN–7, DN–28, Question II. A.

No manufacturer challenged the costs attributed to automatic transmission improvements. Chrysler, the only manufacturer to address the issue specifically, found the costs to be within "an acceptable planning range." DN–30, p. 55. For the purposes of the total cost calculation, the upper bound of the cost range for the four speed automatic transmission was used as a "safe" estimate. This probably overstates the total cost impact, since, as previously noted, it is likely that a variant of the three-speed transmission would in fact be used. Capital requirements associated with the four-speed unit are up to twenty times greater than those for the three-speed (less than $10 million vs. $200 million per standard production facility with a capacity of 500,000 units per year), since relatively inexpensive changes can be made to existing transmission production facilities to accommodate improvements to three speed units, while complete new plants are necessary to produce four speed units.

Reductions in acceleration performance were assumed to be achieved through the substitution of existing smaller displacement engines, up to the maximum level consistent with production flexibility at existing engine plants, at no increased cost. These reductions could also be achieved through axle ratio changes, at negligible cost.

Total required capital expenditure to achieve the postulated fuel economy was generally within the range of planned expenditures for fuel economy improvement over the 1976–85 time period. DN–30 p. 52 (Chrysler); DN–15, Doc. I, p. 20 (Ford); p. I–18, Economic Impact Statement (see sec. VIII infra). However, it is not correct to treat this as a totally "extraordinary" investment required of the automotive industry in order to comply with fuel economy standards. Much of this expense is "integral to the normal cycle of product improvements" which the companies would engage in regardless of the standards. DN–30, p. 55 (Chrysler). The fact that improved fuel economy is itself a highly marketable attribute for passenger automobiles might force th companies to make many of the product improvements discussed in this notice, as a result of competitive market pressures regardless of the fuel economy standards. DN–15, Doc. I, p. 20 (Ford). Conceptually, this means that the automobile companies must, as part of each decision to change a significant component in a passenger automobile, take into account, and possibly reorient their product line in view of, the fuel economy requirements. Therefore, the capital expenditures discussed above have been adjusted to take into account "business-as-usual" reinvestment, which would occur even in the absence of any standards. A further discussion of this topic is contained in the RSP, Reference 27, Chap. 13.

The total cost increases are assumed to be reflected in increased new passenger automobile prices according to the formulas set forth in the Support Document. See Summary Report, p. A–27. Generally, the manufacturers did not object to the total or "bottom line" price changes generated by this methodology, although they did not necessarily agree with all of the details. See, e.g., DN–15, Doc. I, p. 21 (Ford). GM merely noted that price increases are determined by market forces, rather than some arbitrary cost pass through formula. DN–18, p. 24. The Department does not take issue with that statement, but some method must be used to assess price impacts, and no participant in the proceeding suggested a better alternative. Chrysler argued that the methodology did not provide for recovery of the value of the investment itself. DN–32, p. 19. However, it appears that Chrysler has misunderstood the application of the methodology since capital costs are assumed to be recovered by price increases tied to the rate of return on investment. The projected impact on new car prices, as shown in Table 8.1 of the Rulemaking Suport Paper, is an increase of $54 by 1985, as an industry average, relative to 1977 model year automobiles. When gasoline and maintenance savings are considered, net savings to the consumer of approximately $1,000 over the life of the automobile are projected. See Table 8.4, RSP.

The final impacts to be considered in the evaluation of economic practicability are the projected impacts on industry sales and employment. These impacts were projected by using the Wharton Automobile Demand Model. See Support Document, Summary Report, p. A–91. This model is one of the latest and most complex for projecting automobile industry sales and employment. See DN–15, Doc. I, Att. A, p. 176. (Ford); DN–30, p. 38 (Chrysler).

On the basis of this projection, domestic industry sales and employment would attain levels higher than present levels during the 1981–84 period, and would be approximately the same as would be the case if there were no additional costs attributable to fuel economy standards. A sensitivity analysis that assumes a 2 percent per year increase in automobile prices for the 1981–84 model years shows a small decrease in projected sales during those years and a small increase in subsequent years. Since the average change in car prices due to these fuel economy standards for those same model years is only 0.1 percent, the effect on sales is similarly small.

The Department has been unable to quantify the impact of such non-price changes as acceleration capability reductions and exterior downsizing. However, as discussed in section III.A of this notice, these impacts are not expected to be severe. The Department has taken into account any possible adverse impacts in those areas by the provision of a "safety margin" of fuel economy improvement potential and in the discussion of uncertainties in section IV.

The industry generally argued that the uncertainty of consumer acceptance of more fuel efficient vehicles was a major concern in this rulemaking. Tr–I, pp. 19 (Ford), 50 (GM), 78 (AMC), and 104 (Chrysler). However, these statements appear to be more in the nature of fear of the unknown than the result of detailed study and analyses. See Tr–II, pp. 10, 23, 58, 62–64, 121, 146, 161. The Federal Energy Administration's own analyses show that it is the "manufacturer's response to the standards, rather than the consumer demand, that most influences new car fleet average fuel economy under a scenario of little or no market shift." DN–37, p. 2. The provision of a safety margin of technology permits a variety of manufacturer responses.

Improvements in automotive fuel economy, if unaccompanied by adverse impacts on other automobile attributes, are undeniably an aid to marketability. The technological options relied upon are not expected to have such accompanying detriments. Among these options, material substitution, and improvements in accessories, lubricants, aerodynamic characteristics, and rolling resistance are virtually undetectable by consumers, except with respect to price changes, whose impact has been accounted for above. Downsizing, while maintaining or even increasing vehicle interior roominess, has been accomplished without consumer rejection to date, in the case of General Motors' full-size automobiles. Although downsizing of all market classes has yet to be completed, it appears likely that purchasers of the largest size automobiles are the group most concerned about size attributes, and if they are willing to accept downsized vehicles, the purchasers of other market class automobiles would also accept them. With respect to automatic transmission improvements, it appears that past driveability problems with lock-up torque converters are near resolution, in view of some manufacturers near-term implementation plans. Acceleration performance reductions have been limited to those within the manufacturers' stated range of consumer acceptability. Turbochargers could be used to offset even those very modest acceleration reductions. Safety margin technology would permit flexibility in selecting compliance approaches which individual manufacturers find more saleable than the ones projected in this analysis. Further, it is likely that consumer acceptance of fuel efficient automobiles will increase as gasoline prices increase in the future. Therefore, the Department concludes that marketability constraints would not prevent the attainment, in an economically practicable manner, of the standards promulgated herein.

Thus, it appears that the total impact of the fuel economy standards established in this notice is relatively modest, certainly within the "economic capability of the industry." The Department concludes that compliance with these standards is economically practicable.

C. The effect of other Federal standards. The next step in calculating the manufacturers' maximum achievable fuel economy is an assessment of the impact of other motor vehicle standards on fuel economy. It is impossible at this time to predict with perfect accuracy even the level of these standards which will be in effect in the 1981–84 period, since all categories of these standards are either subject to future administrative action or are being reviewed by Congress. Nevertheless, for the purposes of this analysis, it is assumed that the applicable automotive emission standards will be those contained in the Administration proposal, i.e., 0.41 gram per mile hydrocarbons, 3.4 grams per mile carbon monoxide, and 1 gram per mile of nitrogen oxides, with waivers for nitrogen oxides up to 1.5 gram per mile for heavier diesel automobiles, if necessary. The same result would apply under either the House or Senate passed emission standard schedules.

The issue of the impact on fuel economy of various proposed emission standards was one of the more controversial ones in this proceeding. Much development work remains to be done in the emission control area between now and

1981, so projections in this rapidly progressing area necessarily involve some degree of uncertainty. However, the Environmental Protection Agency (EPA) has done extensive evaluation of the emission control systems now under development. The Department of Transportation has worked with the EPA in many of these studies.

Among the more recent of these studies are the February, 1977, report titled "Analysis of Effects of Several Specified Alternative Automobile Emission Control Schedules Upon Fuel Economy and Costs," prepared jointly by the Departments of Commerce and Transportation, the Energy Research and Development Administration, EPA, and FEA; an EPA report dated April, 1977, titled "Automotive Emission Control—The Development Status, Trends, and Outlook as of December 1976;" and the May 19, 1977, "Analysis of Alternative Motor Vehicle Emission Standards." (All of these reports are in the General Reference section of the FE 76–01 Docket.) All three reports evaluate the optimal emission control systems for meeting emission standards at minimum fuel economy penalty, and all three conclude that little or no penalty need result from the use of optimal systems at the level of the proposed emission standards, as compared to 1977 levels. This conclusion was supported by those public interest representatives which participated in this proceeding and addressed the issue. DN–11, p. 8 (Mr. Thomas Austin); DN–12, p. 33 (Citizens for Clean Air); DN–13, p. 16 (Environmental Defense Fund).

As identified in Appendix A of the May 19, 1977 DOT–EPA–FEA report, fuel optimal systems to meet standards of 0.41 HC/3.4 CO/1.0 NOx may be expected to include a three-way catalyst, start catalyst, electronic spark advance, electronic control of exhaust gas recirculation, electronic air-fuel ratio control, oxygen sensor, high energy ignition, improved fuel metering, and a complex electronic control unit. In addition, the heavier cars, those weighing more than 3000 lbs., would have an air injection unit.

The passenger automobile manufacturers' views on the issue of emission standard penalties varied rather widely. Ford stated that the proposed emission standards could be achieved without fuel economy penalty through the use of three-way catalyst and full electronic control technology. DN–15, Doc. I, p. 24, Doc. III, p. 4, Tr.–II, p. 93–4. Volkswagen stated that compliance with the emission standards without a fuel economy penalty was possible. DN–28–01, p. 2. Daimler-Benz projected that compliance with the more stringent emission standards would produce a 3 to 5 percent benefit in fuel economy for the portion of its fleet which presently employs fuel injection. DN–28–05, p. 34.

On the other hand, the remaining domestic manufacturers all project substantial emission standards fuel economy penalties. GM claimed to have experienced fuel economy penalties as high as 20 percent on some prototype vehicles (DN–18, p. 27), although it admits that much development work remains to be done. Tr.–II, p. 124. Chrysler projected a penalty of 12 percent (DN–30, p. 62, DN–35–01, Att. B, p. 27), but projects the use of a control system which is apparently less efficient than that assumed by EPA, DN–30, p. 61, in such areas as the use of electronic spark advance, port liners, and start catalysts. Further, Chrysler's projections were apparently based on actual test data from their 1977 California vehicles, adjusted by some arbitrary amount for future system optimization. These vehicles do not employ three-way catalysts and full electronic controls on which EPA's projections are based. Tr–II, p. 258. Likewise, AMC's projected fuel economy penalties were based on their present California technology, not the advanced system assumed by EPA. DN–14, p. 3. GM also assumes a control system less complex than EPA's by not including the use of such technology as electronic exhaust gas recirculation, electronic air-to-fuel ratio control, port liners, and start catalysts. DN–18, p. 27. GM remains hopeful that, given enough development time, the penalty could be eliminated. Tr–II, p. 124.

Ford notes that, even with the three-way catalyst, a clean up catalyst, and a full electronic system to meet the 0.41 HC, 3.4 CO, 1.0 NOx standard, it would expect a 2 percent difference in average fuel economy between the first and third year of the standards. DN–15, Doc. I, p. 15. The May 19, 1977 DOT–EPA–FEA report observes that:

> "The development of technology to control emissions and permit good fuel economy calibrations to be maintained is expected to take longer than just the development of technology solely for the purpose of controlling emissions. For example, the use of electronic controls which have the potential to be an important part of future low emission, fuel efficient systems will require the generation and analysis of significant quantities of new engine data in order to determine more optimum calibrations."

Thus, it appears that none of the manufacturers presented any evidence which would directly contradict EPA's findings in this area, and in fact some manufacturers supported the "no penalty" assumption. Therefore, it is concluded that compliance with the specified emission standards in the 1981–84 time period can be achieved with little or no fuel economy penalty, through the use of the advanced control technology postulated by EPA. In the technical analysis contained in the RSP, a fuel economy penalty of zero percent is used for all the 1981–84 models.

One other issue with respect to the emission standards was raised by AMC and Chrysler. Those two companies claim that an emission test procedure change recently proposed by EPA (41 FR 38674, Sept. 10, 1976) would, if adopted, adversely affect the derivative fuel economy data. DN–23, p. 2 and DN–30, p. 30. Chrysler projects a very small impact for this revision on fuel economy, to the order of 0.28 mpg. The change in question involves decreasing the magnitude of inertia weight class increments and modification of the road load horsepower requirements. The proposed changes are intended to permit dynamometer testing of vehicles at inertia weight and road load settings that are more representative of actual vehicle weight and road load, so that the resulting fuel economy value would be a more realistic estimate of on-the-road fuel economy. Since this test procedure change is merely a proposal, it is unnecessary to attempt now to quantify the precise impact of any test procedure revisions which EPA may ultimately adopt. It should be noted further that EPA presently believes that the revisions in question should not result in a systematic change in fuel economy data either upward or downward, but rather that the revisions tend to improve the overall accuracy of the data. DN–20, p. 2.

An adjustment is made to each manufacturer's projected fuel economy capability to allow for the added weight associated with Federal Motor Vehicle Safety Standards. To assure adequate crash survivability in the passenger automobiles of the 1980's, additional safety requirements will be necessary. Those requirements are anticipated to cause an estimated 1 percent fuel economy penalty. See RSP.

The Department has no basis at this time to project the existence of any other motor vehicle standards at a specific level. If these projections are proven erroneous by future events, and if the impact of those future standards would substantially reduce the safety margin provided in this notice, it may be necessary to reconsider the standards promulgated herein.

D. *The need of the Nation to conserve energy.* As discussed in section II.B of this notice, this final consideration in establishing maximum feasible average fuel economy levels requires the establishment of fuel economy standards at the highest level consistent with the other statutory considerations.

When the four statutory considerations are considered together, the fuel economy levels achievable by the four domestic manufacturers, as derived from the above analyses, are as set forth in Table 2 below. These numbers are based on a 0 percent emissions penalty. For the reasons discussed in section III.E below, including consideration of the emissions standards, an adjustment is made in that section to Table 2.

TABLE 2

Manufacturer	1981	1982	1983	1984
American Motors	[illegible]	[illegible]	23.1	24.7
Chrysler	[illegible]	[illegible]	26.3	[illegible]
Ford	[illegible]	24.5	26.1	27.0
General Motors	[illegible]	24.2	26.5	[illegible]

E. *Establishing the maximum feasible average fuel economy level.* In determining maximum feasible average fuel economy, the Department cannot simply select the level achievable by the least capable manufacturer in each model year. Instead, an analysis along the lines of that set forth in pages 154–5 of the

Conference Report must be carried out. That Report states:

> Such determination should therefore take industrywide considerations into account. For example, a determination of maximum feasible average fuel economy should not be keyed to the single manufacturer which might have the most difficulty achieving a given level of average fuel economy. Rather, the Secretary must weigh the benefits to the nation of a higher average fuel economy standard against the difficulties of individual automobile manufacturers. Such difficulties, however, should be given appropriate weight in setting the standard in light of the small number of domestic automobile manufacturers that currently exist, and the possible implications for the national economy and for reduced competition associated with a severe strain on any manufacturer. However, it should also be noted that provision has been made for granting relief from penalties under Section 508(b) in situations where competition will suffer significantly if penalties are imposed.

It is clear from this admonition that in certain circumstances the standards must not be set at levels which every manufacturer will be able to achieve in every year. Rather, they should be set at some point above those levels. Whether and how far standards should be set above those levels depends on a balancing of the burdens placed on the manufacturers with lower achievable average fuel economy on one hand against the benefits of a higher standard on the other. This in turn requires an analysis of the impacts of civil penalties imposed on the manufacturers at a given standard level. Implicit in this analysis is consideration of the ability of a manufacturer to apply civil penalty "credits" from other years to reduce or eliminate a penalty and of the ability of the Department to compromise penalties where insolvency, bankruptcy, or substantial lessening of competition may occur. See section 508 of the Act. The latter possibility is especially significant in the case of American Motors, which has reported no taxable income over the past ten years and has suffered serious declines in its sales in the past year, DN–14, p. 6 and Attachments, and whose projected maximum achievable fuel economy is substantially less than its domestic competitors. See Table 2.

When this clarifying language in the Conference Report is applied to the projected maximum feasible fuel economy values for each manufacturer as set forth in Table 2, it becomes clear that in establishing these standards the "least capable" manufacturer should not be the limiting, constraint in determining maximum feasible average fuel economy. From that Table, it appears that the projected maximum feasible level for AMC in the years 1981–84 ranges from approximately one to three miles per gallon less than that of the least capable of the "Big Three" in each of those years. In terms of the nation's petroleum import bill, the cost to consumers of setting the fuel economy standards at the level attainable by AMC as opposed to basing it on that attainable by the "Big Three" could be nearly half a billion dollars in 1983 alone. Against the benefit of avoiding that substantial cost through establishing higher standards, the Department must balance the potential civil penalty liability which AMC could be subject to, which could be up to $145 per automobile sold in 1983. Further, the Department must consider AMC's present small market share of under 3 percent of the domestic market and its resulting relatively small impact on industry employment, and the possibility discussed in the previous paragraph that any civil penalty liability might be mitigated by the Department. In view of these considerations, the Department must not base its determination of maximum feasible average fuel economy on the single domestic manufacturer with the lowest projected fuel economy capability.

While the Department believes that the previoous paragraph correctly applies the statutory criteria, it may paint a misleading picture of AMC's ability to meet fuel economy standards. First, as previously discussed, the projected fuel economy values in Table 2 are based on a limited class of available fuel economy improvement methods. AMC could adopt additional measures to improve fuel economy. Second, a number of further measures are available to relatively small manufacturers such as AMC to achieve major improvements in average fuel economy in a short time period. Among these are the discontinuance of sale of poor fuel economy model types and the purchase of high efficiency engines and other technology from outside sources. Both of these options require minimal capital investment and are readily implementable. The Department has no information on AMC's precise product plans over the next several years, but it appears that some significant initiative is planned which would result in major fuel economy improvements for that company's automotive fleet. Recently, AMC's President predicted that their corporate fuel economy average would achieve 27.5 mpg by the early 1980's. "Ward's Auto World," June 1977, p. 30, Docket Number FE–76–01–GR–16. AMC officers also testified that they expect the average fuel economy of their passenger automobiles to remain competitive with that of the other domestic manufacturers, and not fall significantly below that level, as the Table 2 numbers might indicate. Tr–II, p. 220. Thus, it appears that AMC's future average fuel economy levels may be significantly understated in the DOT analysis, and the resulting civil penalty impact correspondingly overstated.

The Conference Report clarification of the "maximum feasible" requirement also has implications for the "Big Three" manufacturers. Although the fuel economy improvement potentials of those three companies were found to be relatively close numerically, some significant fuel savings benefit could be achieved by setting the fuel economy standard at a level higher than that found to be achievable for the least capable of the three. The harm suffered by those companies as a result of a higher standard is measured by the magnitude of the civil penalties generated. If the calculation of manufacturer-specific fuel economy improvements in Table 2 is correct, and if each manufacturer improved its average fuel economy up to those levels in each year, no net civil penalty liability would result for the "Big Three" if the maximum feasible average fuel economy levels were established as follows: 23.3 mpg for 1981, 24.6 mpg for 1982, 26.1 mpg for 1983, and 27.4 mpg for 1984. At those levels, any civil penalty liability for those companies in one of the affected years would be offset by credits obtained for overachievement in prior or subsequent years. The only obvious adverse impact from adopting this approach would be possible bad publicity resulting from the failure to meet standards. In view of the fact that the Act's sanctions are monetary civil penalties, which can be offset from year to year, no major stigma would attach to single year noncompliance. In fact, the Act's unique enforcement scheme appears to be designed to create economic incentives for encouraging compliance rather than harsh sanctions for noncompliance. Therefore, the Department has concluded that any harm to the individual manufacturers from single year noncompliance would be outweighed by the benefits of establishing "maximum feasible average fuel economy" at levels where these manufacturers would pay no net civil penalty, taking into account their ability to carry credits forward or back.

The Department has concluded that the emissions standards expected to be effective in the early 1980's can be achieved with little or no fuel economy penalty. The analysis of average fuel economy potential discussed above was predicated upon a zero penalty. It appears clear, however, that the engineering and manufacturing problems associated with the introduction of complicated emission control technology may well be substantial, particularly since these advancements will have to be implemented simultaneously with other new technology required to meet fuel economy and safety standards. Although the Department has already tried to ensure the soundness of its average fuel economy standards by making generally conservative conclusions at each step in its analysis, no allowance has yet been made for unforeseen contingencies that may arise due to the need for manufacturers to deal simultaneously with the diverse set of manufacturing requirements imposed by the various fuel economy, emissions, and safety standards that will become effective in the early 1980's, particularly in 1981. Allowing for such contingencies is consistent with the approach taken by the Senate Commerce Committee in establishing the 1980 average fuel economy standard in S. 1883. See S. Rep. No. 179, 94th Cong., 1st Sess. 10 (1975). More important, allowance of these contingencies will ensure that the manufacturers can produce and sell cars that meet energy, environmental, and safety needs of the Nation. It is important to recognize that one limitation

on the rate of product innovation is the rate of consumer acceptance of that innovation. Finally, there are some uncertainties, particularly in the later years of the 1981–84 period, associated with the accuracy of the estimates of the average fuel economy to be gained from the combination of the various technological options.

In view of the factors enumerated in the immediately preceding paragraph, the Department has determined it to be prudent to adjust the no net penalty average fuel economy levels to 22 mpg for 1981, 24 mpg for 1982, 26 mpg for 1983, and 27 mpg for 1984. Based upon consideration of the domestic manufacturers, the Department has determined that these are the maximum feasible levels of average fuel economy for those model years.

IV. The Imports

With the possible exceptions of downsizing, mix shifts, straight-line acceleration reductions, and domestic production of captive imports, the same technological improvement options apply to the imported passenger automobiles as to their domestic counterparts. Since the passenger automobiles produced in foreign countries generally start at a much higher fuel economy base, those passenger automobiles can generally meet any level of average fuel economy which the domestics can attain. However, the possible unavailability of the options listed above and the fact that the U.S. market may account for only a small portion of such manufacturers' total sales necessitate an analysis of the impact of fuel economy standards on the foreign manufacturers.

Total sales of imported automobiles has varied between approximately 15 and 20 percent of total U.S. sales for the past four years. The four largest importers in 1976, Toyota, Nissan (Datsun), Volkswagen, and Honda, accouned for approximately two-thirds of the import total. "Automotive News 1977 Market Data Book Issue," p. 70. Each of these four manufacturers either presently has or will have in the near future an average fuel economy exceeding the 1985 standard of 27.5 mpg. DN–9, p. 1 (Toyota); DN–28–03, p. 1 (Honda); DN–28–04, p. 5 (Nissan); DN–16, p. 2 (VW–projections exclude Rabbit). Therefore, the majority of the import market must only maintain or marginally improve their present average fuel economy levels to comply with these fuel economy standards. Another group of importers, accounting for nine percent of import sales, are presently either meeting the 1985 standard or are in close proximity of that goal. This group includes Subaru, and the captive import fleets of Chrysler and GM. See 1977 EPA/FEA Gas Mileage Guide, Second Edition. Of the remaining manufacturers, which account for a total of slightly more than 20 percent of all imports, Volvo, Daimler Benz, and British Leyland are the largest importers which may face difficulties in meeting a fuel economy standard of 27.5 mpg. Volvo and Daimler-Benz each account for approximately 3 percent of the import total, with British-Leyland accounting for nearly 5 percent.

Volvo projects that it could achieve an average fuel economy level not higher than 24.5 mpg by 1985. DN–28–02, p. 9. This level of fuel economy would result in the imposition of a civil penalty of $150 per passenger automobile sold in the U.S. Since Volvo presently sells its passenger automobiles in the $7,000 to $10,000 range and since demand in that price range is relatively inelastic, the added cost would not be likely to reduce sales substantially. Furthermore, NHTSA believes that it may be possible for Volvo to achieve better fuel economy than it has projected. For example, the Volvo projection is apparently based on the assumption that no weight reduction is achieved, although its 244 model weighs nearly 400 pounds more than a comparable Audi 100LS. See DN–28–02, p. 9 and "Automotive News," supra, at 76–7.

Daimler-Benz projects being able to attain levels of fuel economy close to those projected for the domestic manufacturers (DN–28–05, p. 32), primarily by achieving a diesel market penetration of over 60 percent by 1980. DN–10, p. 8. This projection is also based on relatively little weight reduction. For example, Daimler-Benz projects that by 1985 its two-seater sports model will be in the same or a higher inertia weight class as the GM "hypothetical scenario" projects for large-size six-seater passenger automobiles. DN–28–05, p. 31 and DN–18, p. 13. Even if Daimler-Benz' projections reflected the maximum fuel economy improvement achievable by that company, the civil penalties resulting from noncompliance with the fuel economy standards would likely be less than those mentioned above with respect to Volvo and would have a negligible impact on sales of passenger automobiles whose prices are in the $10,000–$20,000 range.

British Leyland's present product mix is split between relatively inexpensive two-seater sports cars and luxury cars in the Mercedes price range. The small sports cars are highly inefficient even by present standards. For example, the MG Midget and Triumph Spitfire weigh about the same as a Volkswagen Rabbit, yet the Rabbit has roughly 50 percent more horsepower and 25 percent better fuel economy. The Toyota Celica weighs 200 pounds more and has 50 percent more horsepower than the MG–B, yet the Toyota has about 18 percent better fuel economy. See "Automotive News," p. 76, and 1977 EPA/FEA Gas Mileage Guide. Therefore, it seems likely that substantial improvements must be made to the smaller British Leyland products just to be competitive in the U.S. market. If such improvements are made, the British Leyland average fuel economy level would be close enough to the standards promulgated herein to allow any required civil penalties to be passed on to consumers of the luxury passenger automobiles which are responsible for bringing down their average.

In summary, it appears that the manufacturers of the less expensive import passenger automobiles are already in compliance with the applicable fuel economy standards through 1985, or are close to that level now and can readily achieve compliance. The manufacturers of the more expensive imports may face some difficulties in meeting the standards. However, if those difficulties prove to be insurmountable, the manufacturers will incur civil penalties that will be small in comparison to the price of their passenger automobiles. Therefore, and in view of the Congressional admonition against basing these standards on the least fuel efficient manufacturer (see pages 154–5 of the conference report on the Act, S. Rep. No. 94–516, 94th Cong., 1st Sess. (1975), and section III.E of this notice), it is concluded that the establishment of these standards is not constrained by the capabilities of these import manufacturers. A more detailed discussion of the capabilities for improving fuel economy of these manufacturers is contained in Appendix E of the Rulemaking Support Paper. Accordingly, the Department has determined that the maximum feasible average fuel economy levels based upon consideration of domestic and foreign manufacturers are the same as the levels set forth at the end of section III.E.

V. The "Steady Progress" Criterion and Setting the Standards

The final step in the standard-setting process is the application of the "steady progress" criterion. As discussed in section II, this provision requires that the standards increase each year, that all standards fall between 20 and 27.5 mpg, and that none of the resulting annual increases be disproportionate to the other increments. The Department has determined that the maximum feasible levels of average fuel economy specified at the end of Section V meet each of these tests and therefore will result in steady progress toward the 1985 standard of 27.5 mpg. Therefore, average fuel economy standards are: 22 mpg for 1981; 24 mpg for 1982; 26 mpg for 1983; and 27 mpg for 1984.

VI. Additional Comments on the NPRM

Most substantive comments received relating to the establishment of 1981–84 fuel economy standards have been discussed above, primarily in section III, as they relate to the development of the standards. However, certain additional comments on the NPRM deserve further discussion.

The single point raised most frequently in the rulemaking proceeding by the automobile industry did not relate to the technological feasibility or economic practicability of any particular level of average fuel economy, but rather involved the uncertainties inherent in the establishment of these standards. Among the uncertainties raised by industry were the precise fuel economy improvements achievable with the various items of technology, consumer acceptance of the more fuel efficient automobiles to be pro-

duced in the future, the impact of future motor vehicle standards in areas other than fuel economy, and the state of the national economy over the next eight years. Tr–I, p. 106 (Chrysler); Tr–I, p. 53–58 (GM); Doc. IV, pp. 17–35 (Ford). The manufacturers were unable to relate the alleged areas of uncertainty to any particular quantified impacts on sales or to any particular levels of average fuel economy standards. The Department recognizes that areas of uncertainty exist in this proceeding, although not fully agreeing with the manufacturer's assessments of the magnitude of the resulting risks, particularly in the technology area. But cf. Tr–I, p. 53, where GM characterizes the latter uncertainty as "relatively small." The Department also recognizes that in making projections as to future events and capabilities it is not appropriate to engage in a "crystal ball inquiry." "Natural Resources Defense Council v. Morton," 458 F. 2d 827, 837 (D.C. Cir. 1972). Nevertheless, the Act, in requiring that 1981–84 model year fuel economy standards be established by July 1, 1977, necessarily contemplates that standards will be established on the basis of less than perfectly certain information. Nor does the law require such certainty, so long as projections rest on a rational basis, See generally "Ethyl Corp. v. EPA," 541 F. 2d 1, 28 (D.C. Cir. 1976); "National Asphalt Pavement Association v. Train," 539 F. 2d 775, 7834 (D.C. Cir. 1976); "Reserve Mining Co. v. EPA," 514 F. 2d 492, 507 n. 20 (8th Cir. 1975); "Society of the Plastics Industry v. OSHA," 509 F. 2d 1301, 1308 (2d Cir. 1975); "Amoco Oil Co. v. EPA," 501 F. 2d 722, 741 (D.C. Cir. 1974); "Industrial Union Department v. Hodgson," 400 F. 2d 457, 474 (D.C. Cir. 1974). This is especially true in a regulatory program relating to a crucial national need such as energy conservation. "Mobil Oil Co. v. FPC," 417 U.S. 283, 318 (1974).

Substantial efforts have been made to account for the uncertainties involved in establishing these fuel economy standards. For example, as noted in section III, many of the projections of achievable fuel economy improvements are based on conservative estimates of achievable potential. Further, a safety margin of improvement potential is provided to compensate for any unforeseen contingencies. In addition, it is highly likely that some of the uncertainties inherent in this proceeding will operate to the manufacturers' advantage. For example, future technological developments may lead to greater fuel economy improvements than even the most optimistic of the projections made by the Department.

Given that the Department is required to set standards in an area of some uncertainty, it is appropriate to compare the consequences of erring on either the low or the high side in our judgments. This balancing of risks is quite similar to that conducted by the court in "International Harvester Company v. Ruckelshaus," 478 F.2d 615 (D.C. Cir. 1973), involving the EPA Administrator's 1975 automobile emission standards suspension decision. If the Department's projections err on the low side, one obvious consequence is the lost opportunity to conserve energy, the significance of which needs no further discussion. A less obvious consequence is the removal of the "technology forcing" effect of a strict standard. "Union Electric Co. v. EPA," 427 U.S. 246 (1976). Stringent fuel economy standards are likely to encourage the automobile industry to pursue the development and refinement of technology which can reduce fuel consumption. Standards set at easily achievable levels provide no incentive to pursue the development technologies, such as alternative engines, which have substantial fuel economy improvement potential but which may never reach the market in large numbers unless additional technological refinement is accomplished. DN–37, p. 2 (Federal Energy Administration). On the other hand, the danger involved in setting the standards too high is much less than in the "International Harvester" situation. For example, under the Act, the penalty for noncompliance with fuel economy standards is a monetary civil penalty, the magnitude of which is tied to the extent of the violation. On the other hand, violation of Clean Air Act emission standards might result in enjoining the sale of the noncomplying vehicles, conceivably resulting in an industry shutdown. 42 U.S.C. 1857f–4. Fuel economy civil penalties are assessed at a level of five dollars per vehicle per 0.1 mpg of violation, generally within the capability of the automobile companies to either absorb or to pass on to consumers without substantial sales reduction. 15 U.S.C. 2008. In addition, civil penalties incurred in one year can be offset by credits earned in the previous and subsequent years, as previously noted. Penalties large enough to jeopardize a company's continued viability or generated by forces beyond the company's control can be reduced or eliminated. 15 U.S.C. 2008(b)(3). Finally, the Act provides for amending these standards at any time, where the amendment makes the standards less stringent. See section 502(f) of the Act. If some unforeseen contingency arises which makes the attainability of the standards appear dubious, adjustments can be made. The time frame for making these adjustments is much greater than was the case in "International Harvester." All of the technological improvements assumed in this notice are permitted and expected to be phased-in over several years. If problems arise with respect to the marketability or feasibility of the technology, the problem will appear at the start of the phase-in period for the technology, prior to the time when the industry has made irreversible commitments in that area regarding their entire fleets. This contrasts with the "International Harvester" situation where *all* automobiles would have been required to make major technological steps in a single year. Thus, a balancing of the risks involved in setting the standards indicates that less damage is incurred by erring on the high side. In that case, corrections can be made with limited adverse impacts. If the error is on the low side, that error may never become apparent, since additional research efforts would not be fully pursued, and the damage could be irreparable. This counsels against any major reduction in the standards to account for "uncertainties," especially given the safety margin.

VII. Impact of Petroleum Consumption

Section 6 of the Rulemaking Support Paper and section III of the Economic Impact Statement contain discussions of the impacts on petroleum consumption of various fuel economy standards schedules. The RSP concludes that gasoline savings ranging from approximately 9.6 billion gallons per year in 1985 to about twice that amount in the year 1995 are achievable. See Table 6.6, RSP. Over the lives of the passenger automobiles produced in model years 1981–84, gasoline savings of approximately 41 billion gallons would result. These gasoline savings are calculated in relation to a baseline of the gasoline consumption which would have resulted had the new passenger automobile average fuel economy remained at a level of 20 mpg for the year 1980 and thereafter. This baseline was selected because it coincides with the level of the statutory 1980 fuel economy standard, it is consistent with the level of average fuel economy likely to have been voluntarily achieved by the manufacturers, and its use was supported by at least one participant in the proceeding. Tr–II, p. 96; DN–15, Document III, p. 2 (Ford). To put this fuel savings in perspective, the resulting reduction in petroleum consumption could result in a cumulative national savings of approximately 25 billion dollars by the year 1995, at an assumed petroleum price of $13.50 per barrel. See RSP Table 6.7.

VIII. Economic Impact of the Standards

The economic impact of these standards was independently evaluated in accordance with Internal Regulatory Procedures by the NHTSA Office of Planning and Evaluation. This assessment utilizes the assumptions set forth in the RSP and expands upon the analyses in that document. That is, the RSP shows cumulative impacts from 1977 for all fuel economy improvements while the Economic Impact Assessment reflects changes from MY 1980 vehicles due solely to improvements necessary to meet the rule.

To summarize the Economic Impact Assessment, the total change for the Domestic Auto Industry for model years 1981–84 (from a base of MY 1980 and 20 mpg) due to the rule are estimated as follows:

Gasoline consumption for the average vehicle manufactured in MY's 1981–84 will be reduced by approximately 1100 gallons for a total lifetime savings of 1.2 billion barrels; consumer lifetime gasoline costs (at 65 cents per gallon) will be reduced by $640 per car, retail prices will increase by about 3 percent or $175 per car; total consumer costs (that is, retail prices, maintenance costs, and gasoline costs) are anticipated to decrease by about $450 per car or $20 billion

nationally. The domestic industry extraordinary capital requirements are anticipated to increase by $3 billion, new car sales may decrease by about .4 percent or a total of 155,000 vehicles, and total industry employment is estimated to rise by 77,000 jobs due to extraordinary capital expenditures. Most of these impacts can be considered insignificant with the exception of the reduction in gasoline consumption and possibly the increase in industry capital requirements, should sales decline for several years due to unforeseen events.

Sensitivity analyses performed on several of the variables used in the analysis show little change in results. Thus, these results are good approximations of the impacts to be expected from the rule.

It is recognized that the economic projections made in the Department's various economic analyses are subject to possible changes in the national economy and in the structure of the industry, which no one is presently able to predict with perfect accuracy.

IX. Environmental Impact

A detailed analysis of the environmental impacts associated with various alternative fuel economy standard schedules for the 1981–84 period was conducted, consistent with the requirements of the National Environmental Policy Act, 42 U.S.C. 4321, et seq. The analysis concluded that the national goals of a better environment and of energy conservation are generally compatible, in that measures which tend to conserve energy also tend to be beneficial to the environment. The most obvious environmental benefits associated with these standards are the conservation of scarce resources such as petroleum and the various metals which presently go into the automobiles, and the reduction of pollution associated with the extraction and processing of those materials. Most areas of possible adverse environmental impacts, such as the pollution associated with the increased use of lightweight materials, are offset by reductions in pollution associated with the items replaced. The most significant possible exception to this is the still unresolved issue of the generation and potential for control of presently unregulated pollutants from diesel and other alternative engines. The Department has not based its standards on the use of alternative engines at this time primarily for that reason. However, the issue of the environmental impacts associated with the various alternative engines is of major importance, and the EPA is pursuing the matter now.

X. Safety Impact

The NPRM raised a question regarding the impact of occupant safety of downsizing passenger automobiles as a result of the fuel economy standards. Depending upon the assumptions made, reasonable conclusions can be made that there will be little net safety impact or, alternatively that there will be a significant adverse safety impact.

A major reason for suggesting that downsizing might have a significant adverse safety impact is the physical law of conservation of momentum, which indicates that when objects of different mass collide, the smaller object will experience a greater change in velocity than the larger one. DN 18, Att. VII, p. 4 (GM). There, in a collision between a small automobile and a large one, the occupants of the smaller one may collide with the vehicle interior with a greater velocity than would be the case for the occupants of the larger automobile, assuming that seat belts were not used. A further advantage which large automobiles may have is that their additional size may provide for additional energy-absorbing crush space outside the occupant compartment, which may allow the energy of a crash to be dissipated in a manner less injurious to the occupants.

On the other hand, accident information appears to indicate that the chance of injury in single car crashes is not appreciably greater in a small car than in a large car. The reduction in vehicle weight and size will apparently be offset to a substantial degree by the reduction in the range of passenger automobile weights which is projected to occur as the larger automobiles are downsized. Further, smaller automobiles may have certain advantages in terms of accident avoidance which tend to offset their possible disadvantages. One such advantage related to the "target-projectile" effect. See Docket No. FE–76–01–GR–7, p. 40–2 (Mr. Stanley Hart). This effect results from the fact that the larger an automobile is in relationship to a road lane, the more likely it is to hit or be hit by anything else within that lane, and the more likely it is to veer outside its assigned lane because of the reduced margin for error. A corollary to this is the increased ability of a small automobile to maneuver within its lane to avoid other automobiles. Docket No. FE–76–01–GR–8, p. 9 (Prof. P. L. Yu, *et al.*). Furthermore, although the shielding effect of vehicular weight may be an indicator of an automobile's protective ability, that same weight also serves as a weapon with respect to other automobiles and pedestrians. Thus, additional weight in vehicles may be a benefit to the occupant of that particular vehicle but a detriment to other drivers and pedestrians.

Available technology provides the means to argue that the downsized automobile fleet of the 1980's will be as safe, or safer, than the fleet of today. The Department has statutory responsibility under the National Traffic and Motor Vehicle Safety Act to issue motor vehicle safety standards that meet the need for motor vehicle safety. The estimates of fuel economy penalties due to Federal motor vehicle safety standards presume the existence of standards that will yield safety improvements which more than offset any net safety impacts due to reduced vehicle size or weight (see RSP)

The above conclusions should not be construed to mean that passenger automobiles are or will be as safe as possible. Among the actions that could be taken to improve the safety characteristics of future automobiles are techniques described in Volvo's response to the May 10, 1977, special order, such as the use of energy-absorbing structural designs. DN–28–02, p. 11 and Attachment. These techniques could be implemented concurrently with the vehicle redesign which occurs as part of the downsizing process. When representatives of the two largest domestic manufacturers were asked at the fuel economy hearing whether their companies planned to incorporate such techniques as part of the redesign process, they responded that they would do whatever was necessary to comply with applicable safety standards, but presumably no more. Tr–II, p. 86 (Ford) and 187 (GM). The Department encourages the various automakers to consider techniques such as those described by Volvo when present passenger automobiles are redesigned.

XI. 1981–1984 Passenger Automobiles

The passenger automobiles produced during the 1981–84 period will differ significantly from those presently produced. These differences will result not only from the requirements of the Motor Vehicle Information and Cost Savings Act, but also from requirements in the areas of safety and emission control and from market and other forces. It is therefore appropriate to discuss in general terms the implications of all these requirements for the driving public with particular emphasis on the energy-related changes.

The President has recently stated that the nation's energy situation will require actions and possible sacrifices on the part of all citizens. In that context, any sacrifices required of the driving public as a result of these fuel economy standards appear insubstantial, mainly requiring the curtailment of wasteful automotive designs and technology. Such measures reduce the need for additional and possibly severe methods of conserving gasoline, such as reducing vehicle usage, and thus preserve the most important value of passenger automobiles, their contribution to public mobility. In fact, the Department believes that passenger automobiles produced in the 1981–84 period have the potential to be superior overall products as compared to their present counterparts. These future vehicles have the potential to be superior not just from the standpoint of fuel economy, but also in such important areas as emission control and occupant safety, and in terms of technological sophistication and overall reliability. Statements to the effect that 1981–84 fuel economy standards would necessarily force the entire new car buying public into cramped, spartan, 4-seat subcompacts are clearly incorrect in the Department's view. For example, the Department projects that if the present General Motors full-size cars with standard engine were modified in accordance with the options listed in section III of this notice in such areas as material substitution (but not downsizing), improved automatic transmission, lubricants, and accessories, and reduced aerodynamic drag and rolling resistance, the fuel economy of those passenger automobiles would be approximately 25 mpg. If some

form of alternative engine were used in those automobiles, their fuel economy could rise to over 30 mpg.

The most obvious adverse impact of the various changes is that the cost to produce new passenger automobiles will increase. However, the manufacturing cost increases and resulting retail price increases can be held within an acceptable range. Further, these initial price increases are expected to be slight and to be recouped over the life of the automobile, in the form of fuel savings, reduced maintenance expenditures, and societal health benefits from improved emission and safety characteristics. Compared to 1977 automobiles, the net benefit for 1984 automobiles over their lifetime should be more than $1,000.

The Department believes that the 1981–84 passenger automobiles can be designed to have better overall performance characteristics than present ones. The term "performance" is often defined very narrowly as a synonym for high acceleration capability on a straightaway. However, straight-line acceleration is only one aspect of overall driving performance. Other important aspects are maneuverability, handling, reliability, and overall economy of operation. Many of today's passenger automobiles leave substantial room for improvement in these aspects of performance. Compliance with fuel economy standards will create the potential to improve these latter aspects, without major reductions in straight-line acceleration, primarily through the elimination of bulk. The Department's analysis shows that these changes can be accomplished without sacrifice in vehicle roominess and utility. Further changes can be made to future engines. There is no reason to believe that consumers' transportation needs would not be satisfied by such automobiles.

XII. Implications for the Standards for 1985 and Thereafter

For the purposes of this rulemaking proceeding, the Department was constrained to consider standards within a "steady progress" path between the statutorily imposed 1980 standard of 20 mpg and the standard for 1985 and thereafter of 27.5 mpg. However, section 502(a)(4) of the Act authorizes the Department to amend the standard or standards for 1985 and thereafter if it is determined that the statutory level is not in fact the "maximum feasible average fuel economy level" for those years. Our analysis indicates that levels of average fuel economy in excess of 27.5 mpg are achievable in the 1985 time frame. In addition, several areas of additional fuel economy improvement potential deserve exploration. Among these are the impact of whatever new energy legislation ultimately is signed into law on future product mixes, the potential for additional weight reduction through extensive material substitution, and the potential to shift to alternative engines. Because of the limited scope of the present proceeding and time constraints, it was not possible to explore these issues adequately. However, the significant fuel saving potential associated with these items and the high national priority correctly assigned to the need to conserve energy necessitate a consideration of the level of the standards for 1985 and thereafter. Therefore, in the near future the Department will exercise its discretionary authority under section 502(a)(4) of the Act to initiate rulemaking to amend those standards. As part of this rulemaking, it will also be necessary to reconsider the standards promulgated today, to assure that they are set at levels which are both the maximum feasible average fuel economy levels and will result in steady progress toward the selected standard for 1985. However, it is unlikely that the standards for 1981–83 would be significantly revised as part of the reconsideration, given the diminished lead-time for the manufacturers by the time that rulemaking is completed and the need to provide stable planning targets. See Senate Report, *supra*, at p. 21.

(Sec. 9, Pub. L. 89–670, 80 Stat. 931 (49 U.S.C. 1657); Sec. 301, Pub. L. 94–163, 89 Stat. 901 (15 U.S.C. 2002)).

The program official and lawyer principally responsible for the development of this regulation are Stanley R. Scheiner and Roger C. Fairchild, respectively.

Stanley R. Scheiner,
Roger C. Fairchild.

Issued on June 27, 1977.

Brock Adams,
Secretary of Transportation.

1. 49 CFR Chapter V is amended by adding a new Part 531 as follows:

Sec.
531.1 Scope.
531.2 Purpose.
531.3 Applicability.
531.4 Definitions.
531.5 Fuel economy standards.
531.6 Measurement and calculation procedures.

Authority: Sec. 9, Pub. L. 89–670, 80 Stat. 931 (49 U.S.C. 1657); sec. 301, Pub. L. 94–163, 89 Stat. 901 (15 U.S.C. 2002); delegation of authority at 41 FR 25015, June 22, 1976.

§ 531.1 Scope.

This part establishes average fuel economy standards pursuant to section 502(a) of the Motor Vehicle Information and Cost Savings Act, as amended, for passenger automobiles.

§ 531.2 Purpose.

The purpose of this part is to increase the fuel economy of passenger automobiles by establishing minimum levels of average fuel economy for those vehicles.

§ 531.3 Applicability.

This part applies to manufacturers of passenger automobiles.

§ 531.4 Definitions.

(a) *Statutory terms.* (1) The terms "average fuel economy," "manufacture," "manufacturer," and "model year" are used as defined in section 501 of the Act.

(2) The terms "automobile" and "passenger automobile" are used as defined in section 501 of the Act and in accordance with the determination in part 523 of this chapter.

(b) *Other terms.* As used in this part, unless otherwise required by the context—

(1) "Act" means the Motor Vehicle Information and Cost Savings Act, as amended by Pub. L. 94–163.

§ 531.5 Fuel economy standards.

(a) Each manufacturer of passenger automobiles shall comply with the following standards in the model years specified:

Model year:	*Average fuel economy standard (miles per gallon)*
1978	18.0
1979	19.0
1980	20.0
1981	22.0
1982	24.0
1983	26.0
1984	27.0
1985 and thereafter	27.5

§ 531.6 Measurement and calculation procedures.

(a) The average fuel economy of all passenger automobiles that are manufactured by a manufacturer in a model year shall be determined in accordance with procedures established by the Administrator of the Environmental Protection Agency under section 502(a)(1) of the Act and set forth in 40 CFR Part 600.

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